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THE ELECTRIC-VEHICLE LOAD.

The electric vehicle is justly being given a position of prominence by progressive central-station companies as a revenue producer. This is clearly evidenced by the associations being formed which include in their membership central stations, battery manufacturers and vehicle manufacturers, and have as their object a close co-operation between these three co-partners for the general advancement of the industry.

In outlining campaigns for central stations to follow in securing electric-vehicle business, it is advocated that the central station employ battery experts to give free advice to users and prospective users of cars, that it maintain garages for properly taking care of electric trucks, in short that the central station should maintain a relationship with the electric-vehicle user that is analogous to that between the consulting engineer and his client.

Now, while it may seem that much is expected of the central-station companies and that a great deal of gratuitous service is demanded of them in this campaign for increasing the electric-vehicle business, yet the certainty of greatly increased revenues to be derived from the sale of charging energy makes it almost obligatory for them to assist in every possible way, not only in the sale of electric vehicles, but in their care after they have been put into service.

These statements were well borne out in an excellent paper on the subject presented at the first annual convention of the Electric Vehicle Association of America, by Louis A. Ferguson of the Commonwealth Edison Company, Chicago. This company has had an extensive experience with electric vehicles and has carried on investigations to determine the comparative cost of operating electrics. An investigation of the actual cost of operation of six 3,000-pound capacity electric delivery wagons over an average period of one year showed actual cost of operation of six cents per mile when averaging thirty miles per day. The cost included electrical energy at four cents per kilowatt-hour, supplies, tires, battery and all other repairs. These figures demonstrate that the electric commercial truck of today is capable of meeting practically all requirements of the average user, and in addition furnishes him with more economical, cleaner and better service than can be obtained from either the horse-drawn vehicle or the gasoline power wagon.

That the central station is justified in pushing the vehicle business was further demonstrated by figures presented by Mr. Ferguson showing the average monthly income from flats to be $1.84 and from houses $3.08, while the average monthly income from electric pleasure vehicles is $6.87 and for electric trucks between $12.00 and $20.00, depending upon the size.

CENTRAL-STATION HEATING.

At a meeting of the New England Section of the National Electric Light Association on September 9, 1909, Mr. Charles R. Bishop stated that out of eighty-two cities in Pennsylvania having a population of 5,000, there were at that time no less than sixty-nine cities which could boast of central-station heating plants. Mr. Bishop, who is a well known authority on the subject, claims that exhaust-steam heating is much more profitable than live-steam heating, and even the most elementary acquaintance with the thermodynamic and engineering considerations of the subject will tend to show that there is every reason for this contention, and operating figures from the various plants amply bear out Mr. Bishop's viewpoint.

These facts lend interest to a short article by Mr. P. E. Matteson on "Central Heating" which appears on another page of this issue as the fourth and concluding article of a series on "Central-Station Economy."

Mr. Matteson points out that the conditions are generally favorable for central heating from an electric generating station, and considers the case of a small station employing an engine of 200 horsepower. The figures he gives, however, are seldom if ever attained in ordinary practice, but as he takes probably the most unfavorable viewpoint statistically, his arguments are really only strengthened when more typical cases are considered.

Thus, Mr. Matteson assumes a temperature of only 200 degrees Fahrenheit for the product of his water heater. A figure of 208 degrees would be more nearly true under favorable conditions and with efficient apparatus, and it may safely be said that if the temperature drops below 204 degrees there is something wrong with the apparatus. Again, he assumes the performance of a 200-horsepower noncondensing engine to be eighteen pounds of steam per horsepower-hour. It is doubtful whether any electric-light plant with an engine of this size ever approached such an efficiency when operating noncondensing; twenty-five to thirty-five pounds would represent common practice in this respect, and indeed much higher figures than these have been noted. But then the more exhaust steam there is available, the greater are the possible returns from the heating proposition, so that Mr. Matteson's conclusions are strengthened by a consideration of probable working conditions, instead of being invalidated.

Thus it would appear that with most small central stations, which usually are inefficiently operated, the steam-heating proposition should be a good one, and in many cases it will be shown that the main revenue will accrue not from the sale of current but from the heating returns.

In this connection the statistics quoted by Mr. Bishop for a city of 10,000 inhabitants will be of interest. At a rate of only 40 cents per 1,000 pounds of exhaust steam, the yearly revenue from the heating amounted to $12,497.85. And as a rate from 25 to 50 per cent more than this is often obtained, the great possibilities of central heating will be readily apparent.

Another argument frequently advanced for the establishment of a heating business by electrical generating stations is that in many cases the fact of their being able to furnish heat will often result in an order for electrical supply which otherwise could not be obtained. Hotels, apartment houses, office buildings, and the like, must have heat in the winter, and this is always more imperative than the nature or source of the lighting. It must not be stated positively, however, that a central heating supply will invariably result in such cases in obtaining an electrical contract—there are other important considerations also—but doubtless in many cases it will prove ultimately to be the deciding factor.

THE ELEMENTARY CHARGE OF ELECTRICITY.

Parallel with the growth of the electronic theory of electricity has been the growth of the belief in the existence of an elementary electrical charge, an electrical atom, as it were. And just at the period when our faith in the indivisibility of the material atom has been shattered by the phenomenon of radioactivity, the evidence of the atomic structure of electricity has been accumulating. Various attempts have been made to measure the magnitude of this natural unit of electrical quantity, by a number of methods, and its approximate value has been known for some time. One of these methods consists in condensing water vapor in a fog chamber, the air of which has been cleansed of dust. With no dust particles present, the vapor condenses on the ionized particles of air as nuclei, and the droplets forming the cloud are thus electrically charged. By observing the rate of fall of this cloud, under gravitation alone, and with a superposed electrical field, the data necessary for the computation are obtained.

In a paper read before the American Electrochemical Society, at its recent meeting, and reported in abstract in our last issue, Prof. Robert A. Millikan described some experiments along this line which are noteworthy. For elegance of method and accuracy of result his work surpasses anything which has yet been done on this subject. The method is a modification of the cloud experiment mentioned above. As first reported at the meeting of the American Physical Society about a year ago, a single dish of wa-

ter was brought under observation in the dust-free chamber, and its motion could be observed through a reading telescope much more accurately than that of a cloud. But on account of gradual evaporation, the mass of the drop kept changing, and as the velocity of motion depends upon gravitational as well as electrical attraction, the conditions were not sufficiently constant to permit accurate results. In the later experiments oil has been substituted for water, the tiny drops being obtained by the use of an atomizer. One of these finds its way eventually into the chamber through a pin-hole, and can then be subjected to observation. The mass, as determined from the velocity under gravity alone, remains very nearly constant and it consequently forms a very satisfactory material. Due to contact with ionized particles of air, or to the acquisition of free electrons, the charge of the droplet sometimes suddenly changes, producing a corresponding sudden change in its velocity of motion. These changes of charge are usually by a definite amount, either positive or negative, but occasionally by a multiple of this, as though ten electrons had been acquired at the same time. The value of this elementary quantity, computed from the observations, is 4.90×10^{-10} C. G. S. electrostatic units. Since the relation connecting the velocity of fall with the mass of the particle involves the viscosity of the air, its accuracy is limited by our knowledge of the latter, which is uncertain, to about one-half per cent.

The reason given for considering this quantity as the ultimate electrical atom, or natural unit of electricity, is, that the charge upon the drop never changes except by this definite amount, or an exact multiple of it. Moreover, when the drop comes initially under observation it possesses a charge which is also an exact multiple of this minimum charge. This charge probably arises from the method of spraying the liquid from the atomizer, but it is also possible that it is accumulated from the air in the same fashion as the later additions. In the latter case the question arises as to whether this definite charge is not simply a quantity which is invariably associated with a molecule of air, just as in an electrolytic bath a definite ratio appears to be maintained between the mass of any ion liberated and the quantity of electricity transferred. If air were a simple chemical substance, such a supposition would seem very plausible, but as it is not, it would be necessary to assume that the ionization occurred in one constituent alone, such as the oxygen. There is no reason to suppose that this is the case, but the argument for the electrical atom will be strengthened when other gases, such as hydrogen, are found to give the same result. It is pleasing to know that Professor Millikan proposes to try the experiment with other gases, and thus add to the evidence in hand. He has already found that the result is independent of the material used for the liquid drop.

NATURAL UNITS OF MEASUREMENT.

The existence of an elementary charge or electrical atom suggests at once that such a natural unit should be used as a unit of measurement, or at least that the unit of measurement for electrical quantity should be based upon it. The suggestion has indeed been made that our entire system of units be based upon such constants of nature, such as the velocity of light in space, and it is of course possible to construct such a system. While such a system may appeal to sentiment, it has little to recommend it from a practical standpoint. Its principal advantage is that the unit is independently reproducible, and does not depend upon the preservation of any particular piece or pieces of matter, such as are now preserved by our own and other governments to perpetuate the kilogram, foot, etc. The units not only would be independent of any particular body, but would not even depend upon the properties of any particular substance.

An objection to such fundamental units is that they are not conveniently available for direct use. Another is, that most of them are not known with the accuracy which is possible with our present units. As to reproducibility, when the relation between one of these constants of nature and our present units is once determined, the unit can then be reproduced regardless of its particular value. Such a relation has been determined, for instance, by Professor A. A. Michelson, between the meter and the wave-length of a particular line in the spectrum of cadmium, and the meter can consequently be reproduced at any time from the knowledge of this relation, even though every standard of length in the world should be destroyed. A similar consideration applies to the unit of electrical quantity, and the natural unit in this case is inconveniently small. For practical purposes it is immaterial whether the unit employed is an exact multiple of the natural unit, or bears an entirely arbitrary relation to it.

WINDING COEFFICIENTS FOR MOTORS.

The last installment of an article by Mr. Hans Weichsel dealing with winding coefficients for single-phase motors appears in this issue. The possible variety in the design of windings for this class of machine is so great that it is of great service to the designer to have within convenient reach the values of the necessary coefficients which apply to any particular arrangement of winding which may be chosen. The curves and tables given by Mr. Weichsel, as well as the derivation of the necessary equations for determining these coefficients, will therefore prove of great value to all those who are concerned with the design of single-phase motors.

This valuable series of articles should be preserved and filed, and will be found very convenient for reference purposes.

Sons of Jove Annual Meeting.

The eighth annual meeting of the Order of Rejuvenated Sons of Jove was held at Birmingham, Ala., on October 13, 14 and 15, 1910, with headquarters at the Hotel Hillman. Members of the Order from all parts of the country were present and gave voice to their appreciation of the generous hospitality of the local Jovians and the management of the convention. The entire business section of the city was decorated and illuminated by hundreds of unique electrical signs, Jovian flags and banners, cards of welcome in store windows and other devices. Suspended across the street from the Hillman to the City Hall was an illuminated WELCOME JOVIANS! flanked on either side by representations of Lucifer, the God of Light, the emblem of the order, worked out in green and red lights. Stretched across the principal business streets were hundreds of arches and festoons of electric lights, forming continuous avenues of illumination, under which the Jovians passed in parade.

Business sessions were held each day in the City Council Chambers, through the courtesy of the Mayor, the Honorable Culpepper Exum, who later was initiated and received into the Order. Entertainment included a theater party, smoker and vaudeville at the Turn Verein, a visit to the Alabama State Fair, automobile trips about the city, visits to the great steel and iron mills at Ensley and Bessemer, and a banquet, at which Jovian A. H. Ford, president of the Birmingham Railway, Light & Power Company, presided as toastmaster.

The retiring Eighth Jupiter, Oscar C. Turner, of Birmingham, in his report showed an increase of more than 1,000 members during the past year, and a total membership close to 4,000. Mercury R. M. Van Vliet, of Chicago, presented an interesting report covering the work of Jovian Headquarters at Chicago, outlining clearly the enormous amount of detail work in connection with the keeping of the records and the editing of the Jovian Bulletin under the supervision of the general office manager, Jovian E. D. Strickland. The financial report showed a satisfactory balance in the treasury. Plans for larger usefulness and greater service to the entire electrical field were discussed and arranged. The idea of co-operative advertising, as now carried on in Buffalo, Cleveland and other centers of Jovian interest, is to be embodied in the work of the Order and to be fostered and inaugurated wherever possible. Past-Jupiter J. Robert Crouse, of Cleveland, Ohio, in presenting the possibilities of co-operative advertising called it "the bunching of hits" and declared that the plan had all the virtues of a commercial invention. Briefly, the idea is to have Jovians in various large centers purchase and manage a page in one or more of the leading local newspapers to be used in exploiting electricity in all its branches on one or more fixed days each week. The various electrical interests, large and small, contract for advertising space surrounding a solid center given over to items of general news interest regarding electricity. "Co-operation" is the watchword of the Sons of Jove and the plan of co-operative advertising outlined above is practical Jovianism. Other plans for increasing the scope and usefulness of the order also received attention.

The convention closed with the reception of thirty new members at a rejuvenation held on Saturday evening. The following were chosen as the officers for the ensuing year:

Jupiter, J. F. Dostal, Denver Gas & Electric Company, Denver, Col.

Neptune, H. B. Crouse, Crouse-Hinds Company, Syracuse, N. Y.

Pluto, J. P. Lawrence, Nashville, Tenn.

Vulcan, C. C. Hillis, Electric Appliance Company, San Francisco, Cal.

Mercury, R. M. Van Vliet, Cutler-Hammer Manufacturing Company, Chicago, Ill.

Mars, A. C. Beattie, Cincinnati, Ohio.

Hercules, M. F. Sterritt, Hobson Electric Company, Dallas, Tex.

Apollo, W. N. Matthews, W. N. Matthews & Brother, St. Louis, Mo.

Avrenim, R C. Kemp, Montana Electric Company, Butte, Mont.

Denver Jovians initiated one hundred and ten members, the largest class ever received, on October 11, and flooded the convention with telegrams from the Governor of Colorado, the Mayor and President of the Denver City Council, officers and past officers of the National Electric Light Association and a hundred or more Jovians. This display of electrical energy secured for Denver the office of Jupiter and the next annual meeting of the Order of Rejuvenated Sons of Jove. It means also a renewed interest in the work of the Order on the part of every central-station manager throughout the country. The Denver Electric Show next year, it is promised, will be Jovian from start to finish. The slogan and vital principle of the Sons of Jove is "All Together, All the Time, for Everything Electrical."

Commercial Section Formed.

At the St. Louis convention of the National Electric Light Association, Vice-President Gilchrist appointed a committee on the organization of a Commercial Section, of which George Williams is Chairman.

The first meeting of this Committee was held in the rooms of the Association, New York City, on October 17. A plan of organization with constitution and by-laws was presented by Chairman Williams and was unanimously adopted. This plan provides for the formation of a Commercial Committee with the Chairman and Secretary as officers. Each member of the Commercial Committee is in turn chairman of a subcommittee appointed to investigate and report upon specific department of central-station commerical work. Through this plan of organization it is hoped that the Association will have each year very complete and authoritative reports of commercial progress.

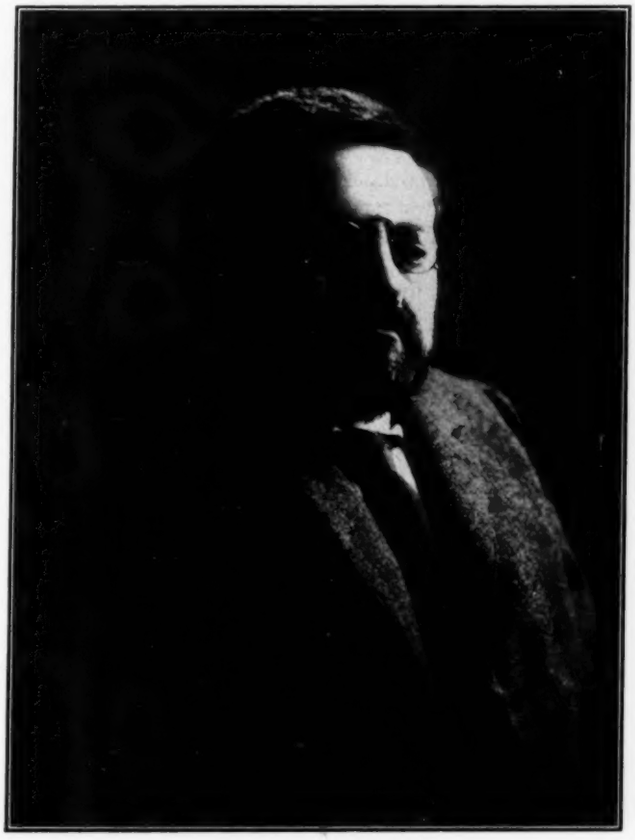
At the conclusion of the session it was determined to call a second meeting on November 10 at Pittsburg, where nominations for the various committees will be made and their work outlined. The secretary of the committee is Frank B. Rae, Jr.

To Investigate Sanitation of Cars.

At the annual convention of the American Association of Railway Surgeons held in Chicago on October 19, 20 and 21, a committee was appointed to make an investigation of, among other things, the best means to promote more perfect sanitary conditions in railway passenger cars. Particular attention will be given to car ventilation, fumigation and cleaning. Dr. A. M. Hume, of Owosso, Mich., chief surgeon of the Ann Arbor Railroad, is chairman of this Committee on Hygiene and Railway Sanitation.

Charles P. Steinmetz.

To be one of the foremost masters of both theoretical and applied science and at the same time a conspicuous leader in their further advancement is a position held by but few living men. This country is fortunate in having such a leader in its electrical activities, a man of the Lord Kelvin class, who is revered by all electrical men and regarded as a most gifted genius. No important electrical problem, particularly if of an intricate nature, is solved without ascertaining the opinions of Dr. Steinmetz. No student of electrical engineering fails to hear of him. And yet there are a great many of the younger electrical men who do not know the romantic story of this truly wonderful man.



CHARLES P. STEINMETZ,
Electrical Engineer, Inventor, Lecturer, Author.

Charles Proteus Steinmetz was born on April 9, 1865, at Breslau, Germany. From his father he inherited a keen interest in scientific subjects which manifested itself at an early age. As his father was in fair circumstances he was sure of getting a thorough education. Twelve years he spent in the gymnasium, or preparatory school. Here was laid the foundation for his complete mastery of mathematics. Much of this time was also given to his other pet hobby, chemistry, and a private laboratory was fitted up at his home. At the age of nineteen he entered the university at Berlin, specializing first on mathematics and astronomy and later on physics and electrical engineering.

Through a fellow student he became intensely interested in socialism, and before long he was made editor of a weekly socialist paper, although he was already editor of two scientific periodicals. At that time the socialistic propaganda was not tolerated in Germany, so the greatest ingenuity was necessary in order to circumvent the surveillance of the police. Communication with imprisoned comrades was maintained by means of letters written with invisible ink. Finally suspicion fell on young Steinmetz for the publication of the secret paper. Flight seemed the only way out of the dilemma, so through a carefully planned ruse he escaped across the Austrian border and spent a short time in Vienna.

In June, 1888, he went to Zürich, Switzerland, where he arranged to replenish his funds by writing articles on astronomy. Although he had intended to become a chemist, he decided to study mechanical engineering and therefore entered the Zürich Polytechnicum. A year later he and his closest chum decided to go to America and took passage in the steerage of a French liner. During the trip they studied English.

Arriving in New York Mr. Steinmetz fortunately had a letter of introduction from the editor of the *Elektrotehnische Zeitschrift* through which he secured a position as draftsman in the electrical shops of Mr. Eickemeyer, at Yonkers, N. Y. Here promotion was rapid and in a few years Mr. Steinmetz was chief designer and in full charge of all new and experimental work. Soon after the merging of a number of large electrical concerns to form the General Electric Company, the Eickemeyer Company was bought up in order, it is said, to secure the services of its young expert.

Since then, 1893, Dr. Steinmetz has been the consulting engineer of the General Electric Company. He is particularly associated with its research work and has conducted a multitude of difficult investigations. He has been granted a large number of patents for his electrical and other inventions. He is singularly gifted in being able readily to pick out the essentials of any abstruse problem and to solve it with short-cut methods. Daily his advice is sought on points that require bridging from the science to the art of electrical engineering.

He has always taken deep interest in the affairs of the American Institute of Electrical Engineers, to whose proceedings he has been a prolific contributor of original papers. After holding numerous offices he was elected president of the Institute in 1901.

As a lecturer Dr. Steinmetz is always in demand. His versatility and his keen insight enable him to discourse fluently and with remarkable clearness on any electrical engineering topic. Since 1902 he has been professor of electrical engineering at Union University.

Despite his numerous interests he has found time to write five books, which have become classics in electrical literature. These are: "Theory and Calculation of Alternating Current Phenomena," "Theoretical Elements of Electrical Engineering," "Theory and Calculation of Transient Electric Phenomena and Oscillations," "General Lectures on Electrical Engineering," "Radiation, Light and Illumination."

For diversion Dr. Steinmetz finds much delight in nature study. His summer vacations are spent in the most primitive fashion at a small camp along the Mohawk. At home, when not in his laboratory, he may be found fondly watching his plants, particularly cacti and aquatic plants. His conservatory is a most interesting one.

Steinmetz Speaks Before the Chicago Electric Club.

The speaker of the day at the regular weekly meeting of the Chicago Electric Club on Thursday, October 20, was Dr. Charles P. Steinmetz, who delivered a very interesting and characteristic address on the various phases of electricity, treating briefly its generation, transmission, application and its future.

Doctor Steinmetz spoke of energy in its different forms, mentioning the characteristics of each. He classified electrical energy as that form of energy which may easily be converted into light and power and chemical energy as being easily converted into heat. The speaker discussed the sources of energy and briefly outlined the methods of converting it into forms for commercial use.

Regarding transmission, Doctor Steinmetz said that an essential advantage of electrical energy lies in the fact that it may very easily be transmitted from place to place with comparatively small loss. This was explained as being a great advantage in view of the fact that energy is seldom utilized at its source of supply and must necessarily be transported. Electrical energy was further defined as an intermediate form of energy as it is never used in the form in which it is transmitted.

The next phase considered by the speaker was the time element. The fact that electrical energy must be used when generated is the most serious disadvantage of electricity. Doctor Steinmetz referred to the storage battery and stated that it does not store electrical energy but instead charges plates which create a chemical action, thus regenerating current.

Considering the central stations next, Doctor Steinmetz spoke of the investments involved, of the character of the loads carried and the various conditions which govern charges. He said the cost of production was essentially the fixed cost and therefore the cost of power depends upon the uniformity of use.

In closing Doctor Steinmetz said in the consolidation of electric companies, such as first took place in Chicago, lie economies which were never before dreamed of.

W. Clyde Jones spoke briefly following this address. He referred to the days when Bell, Edison and Brush were making their first experiments and commented on the wonderful development of the electrical industry. He recounted an experience he had in installing which is known as the first arc-light installation in a mine, at Ashland, Mich. Referring to water power Mr. Jones said that by the development of electrical apparatus the people are beginning to utilize the water power of the country and he looks forward to the time when the conservation of our natural resources will be all that the name implies.

Homer E. Neisz, vice-president of the club, commented Doctor Steinmetz on his interesting address and moved that a vote of thanks be extended him by the club. It was also moved and adopted that Doctor Steinmetz be made a honorary member of the Chicago Electric Club.

Changes in New York Wiring Rules.

The Department of Water Supply, Gas and Electricity of the City of New York has announced changes in the electrical rules to take effect on November 1. Fuses of the standard rating nearest to the capacity of the wire will hereafter be allowed, even though the rating of the fuse is slightly higher than the rating of the wire. The present sign rules are superseded by the following, to be known as Rule 12-D:

a. Wires carried on the outside of sign structures must be run in approved metal conduit or approved armored cable. This does not apply to signs erected on roofs or on open ground where rubber-covered wire is employed and is not subject to mechanical injury, and where it is kept at least one inch from the surface wired over.

b. Wires within structure of sign must be double-braided rubber covered and where the difference of potential between wires is over 120 volts they must be separated by at least 0.5 inch.

c. Must be constructed entirely of metal.

d. Sheet metal must not be less than No. 26 B. & S. gauge.

e. Must be braced by angle iron of such thickness and so placed as to secure sufficient strength and rigidity.

f. All metal must be galvanized or enameled or treated with at least three coats of anti-corrosive paint or compound.

g. If the terminals of receptacles are not of the inclosed type, receptacles must be constructed that the terminals will be at least one inch from the surface wired over. Wires must be soldered to terminals, and exposed parts must be treated to prevent corrosion.

h. All signs must be made weatherproof, and each compartment must have suitable provision for drainage.

i. Where wires pass out or into cut-out box they must be protected by approved tubes or bushings.

j. Where wires not inferior in size and insulation to approved No. 14 B. & S. gauge rubber-covered wire is used connecting direct to standard sockets or receptacles, 1,320 watts may be dependent upon final cut-out.

k. Must have maker's name or trade mark permanently attached to the exterior.

l. Must be constructed as to render each compartment accessible for inspection, or in lieu thereof must be inspected and labeled at the factory.

American Iron & Steel Institute.

On Thursday, October 20, a party of steel and iron men began a two days' inspection of the steel and iron industries of Pittsburg. About fifty members of the American Iron and Steel Institute and a number of foreigners made the tour, there being about seventy-five in all.

In addition to the Pittsburg visit the members have also visited the industries in Buffalo, Niagara Falls, and Chicago.

The inspection party enjoyed a banquet at the Hotel Schenley, at which Judge E. H. Gary spoke. After the banquet the party left for Washington, D. C.

Another Institute Meeting.

The Board of Directors of the American Institute of Electrical Engineers has given authority for an Institute meeting to be held with the co-operation of the Pittsfield and Schenectady Sections. The time suggested is February, 1911, the exact date to be fixed later.

American Physical Society.

The regular Thanksgiving meeting of the American Physical Society will be held in Chicago on Saturday, November 26. The secretary in the advance notice calls the attention of members to the necessity of sending in abstracts of their papers as soon as possible.

Electrical Exports for October.

During the month of September electrical machinery valued at $500,000 was exported from the United States. This is less than the exports for last September by about $100,000. Exports of electrical machinery for the nine months ending with September amounted to $5,400,000.

Electrical Imports Into South Africa.

Electrical fittings valued at $1,110,000 were imported into British South Africa during the first seven months of 1910, against only $368,000 worth in the same period last year.

The Power Equipment of the Buick Automobile Company.

A New Installation Comprising Some Unique Features.

Although not of remarkable size the power plant of the Buick Automobile Company, located at Flint, Mich., possesses a number of features, both in regard to its system of distribution and to its equipment, that are of interest to the power engineer. The plant is one of the few in which power is distributed through underground conduits, and only over a short distance. The entire equipment, especially that of the distribution system, is a model of its kind, and aside from its neatness and compactness is so arranged as to be easily accessible in case of repairs which might at any time become necessary.

The factory of the Buick Company, which uses power generated by the Flint Power Syndicate comprises fourteen buildings, extending over an area of about 100 acres. When the works are operating at full capacity between 8,000 and 9,000 men are employed and an average of about 180 complete automobiles are produced each working day.

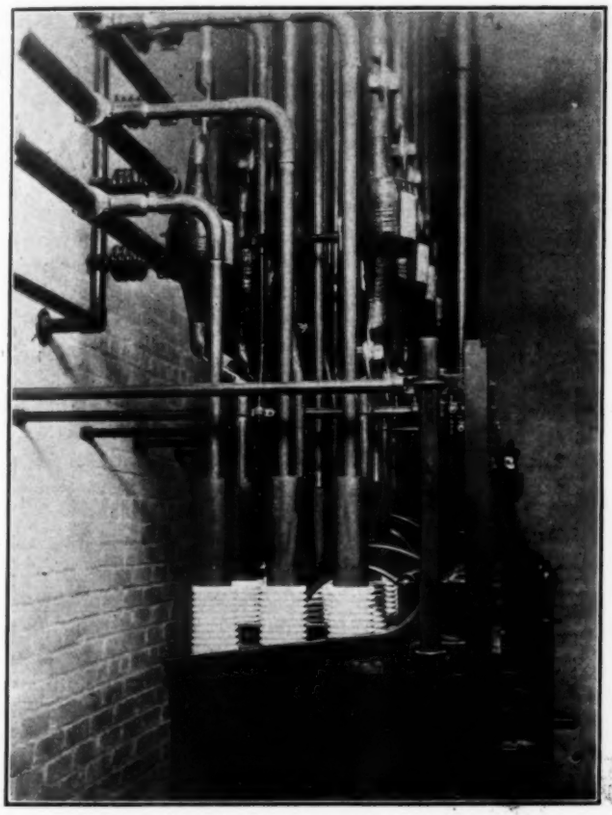
As a great deal of the machinery in the factory is small and is run at constant speed the machines have been divided into groups and are driven by constant-speed induction motors. On machines liable to sudden and quite heavy overloads, such as the drop-forging machines, the motor has been provided with a heavy flywheel.

The power plant of the Flint Power Syndicate supplies power not only to the Buick Company, but to other allied plants in the immediate vicinity, having power sufficient for all their needs. In the boiler room of this generating plant are four batteries of 1,200-horsepower Stirling boilers, sufficient room being left for the installation of four more when it becomes necessary. Automatic stokers are used, coal being received in bins at the top of the boiler room. A traveling crane is used to transfer the coal from the cars on the Company's siding into the bins. As an aid in keeping accurate cost accounts of the power plant all coal used is automatically weighed and stamped on cards when dumped into the bin.

Water supply for the boilers is brought directly from the Flint River, on the bank of which the station is situated.

Power is supplied to the transmission system by one vertical and one horizontal General Electric turbine of 3,500-kilowatt capacity each. All power is three-phase, sixty-cycle and is generated and transmitted at 6,000 volts. From the turbo-generator five three-conductor cables run through oil-switch panels to the underground conduit system.

Each of the five cables used in transmitting power is insulated with varnished cambric and is lead-covered. Each will, at 6,000 volts, transmit 2,500 kilowatts. These cables are all built on 24,000-volt specifications and were tested for 40,000 volts. In order to accommodate this cable especially large conduits were built and conduit work amounting to 32,000 duct feet was in-



BUSBARS AND OIL SWITCHES IN BUILDING NO. 11.

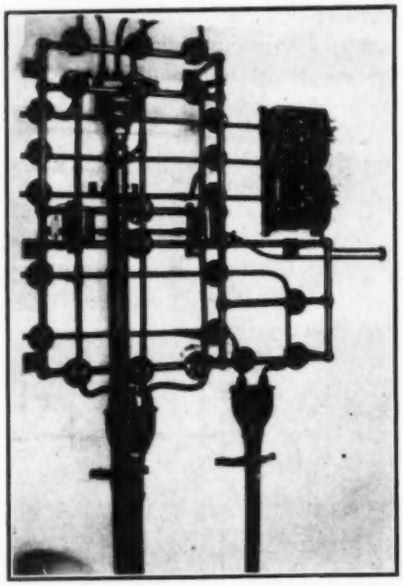
INTERIOR OF POWER HOUSE, FLINT POWER SYNDICATE.

stalled by G. M. Gest, of New York, Cincinnati and Chicago.

Leaving the generating station the five three-conductor cables, branching out from junction boxes, run to nine transformer stations. In nearly every case the factory building receives power from its own individual transformer stations, though in some of the shops this order is varied. One building is provided with two such stations while in other cases a shop receives its power from a transformer located in another building. Building No. 1, which contains automatic lathes, drill-presses, etc., is fed from two transformer stations, views in one of which are shown on this page. In each of these installations there is one 750-kilowatt transformer which supplies power to the motors, one 200-kilowatt transformer supplying current for lighting. The entire equipment of the two stations is practically identical. Building No. 3, in which the drop forgings are made, and Building No. 6 where cars are assembled, each have one 750-kilowatt transformer for power and one 200-kilowatt transformer for lighting. The body works in Building No. 4 has the same power equipment but only a fifty-kilowatt transformer for lighting. Building No. 7, which also supplies power to No. 8, has a capacity of 200 kilowatts for lighting and 375 kilowatts for power. This plant, being used for assembling, requires less power than some of the others. The sheet-metal plant in Building No. 7, the assembling plant in No. 10, and the assembling plant for the No. 14 Type car, are each equipped with stations containing one 750 and one 200-kilowatt transformers.

The busbar construction used in all the transformer stations is one of the unique features of the installation, as instead of the ordinary busbars of rectangular section, tubular bars are used throughout. These copper, seamless drawn tubes are all made to micrometer measurement, both inside and outside, in order to make certain a constant cross section and to insure an accurate fit at points where connections are made. Where any connection is made between two of these tubular bars the outside tube is shrunk over the tube of smaller diameter which has previously been tinned. Even in case of extreme overload there is no danger of such a joint heating and separating, as the expansion of both tubes would be practically the same.

The lower heating effect is, however, one of the main reasons for which the tubular bars were installed, and it is estimated that with an allowance of



HIGH-TENSION BUSBAR ARRANGEMENT.

1,600 circular mils per ampere, bars of this construction will heat in about the same proportion as rectangular bars where 2,000 circular mils per ampere is allowed. It is well known that in copper conductors of large cross sec-

OIL SWITCHES IN BUILDING NO. 1.

tion carrying alternating current there is a decided skin effect, and that the current density at the middle of such conductors is quite low as compared to the density at the periphery. The use of the bars of tubular section practically eliminates this difficulty and the copper is used to the best advantage. The cooling effect is considerably increased by the much greater surface exposed to the air.

Going through the oil switches at each transformer station the cables are carried out through iron conduits, this style of construction being used throughout each of the fourteen factory buildings. In all the transformer stations a total of fifty-two Type K General Electric oil switches are used, ranging in capacity from 500 to 2,000 amperes. In order to take care of possible breakdowns each factory has been divided into a number of sections, duplicate cables running to distributing boxes in different parts of the building. Building No. 1 is divided into ten such sections each good for 800 horsepower, while the other factories have a smaller number.

All current for lighting goes into the factory building at 110-220 volts, single phase on a three-wire system. The power circuit is all three-phase, 440-volt, sixty cycles. From the transformer house to the factory the cables for both lighting and power are carried in tubular iron conduits fitted with metal outlet boxes.

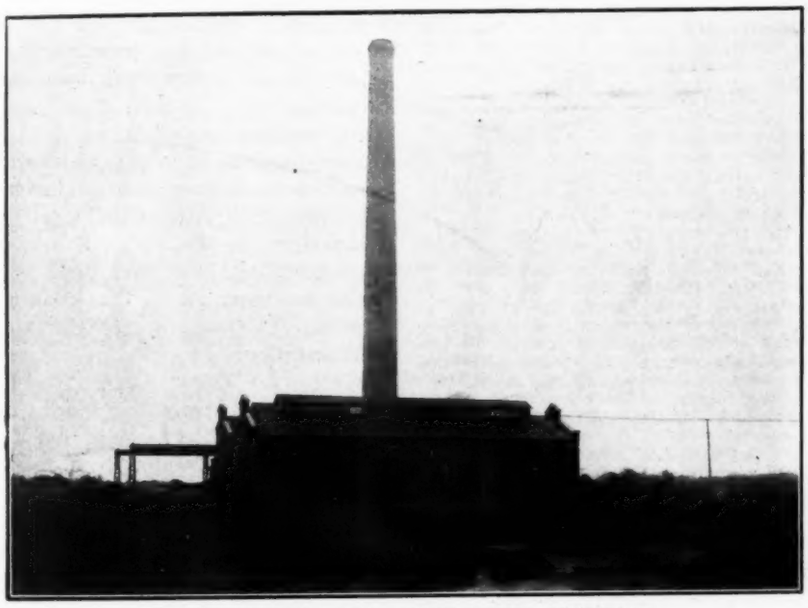
As previously mentioned, the machines are of such a character as to permit the use of constant-speed motors, and throughout the works General Electric induction motors with squirrel-cage rotors are used. These motors are for the most part suspended from the ceiling, and range in size from five to 100 horsepower. There are in all 147 motors, each belted to groups of machines. A number of small motors are used for fans, blowers and other small miscellaneous apparatus.

Each motor is equipped with an automatic overload and no-load release motor starter. The time-limit feature has been incorporated in this new type of starter so that with a momentary overload, where a fuse would be blown there is with this device no interruption of the power supply. It is also impossible with this type of starter to leave the lever in the starting position, thus avoiding trouble; for even though the motors are started by a foreman who is thoroughly instructed there is always a chance that he will leave the lever in the wrong position if this is possible.

In arranging the groups of machines throughout the shops the steps in the

process of manufacture were taken into consideration so that the parts going into one section of the shop are carried through, coming out finished. This arrangement, made easy by the application of motors to groups of machines, saves much time which would be lost by taking pieces from one part of the shop to another in a haphazard manner.

The buildings, which are all roomy and for the most part, one, two or three-story structures, are exceptionally well lighted both by day and by night. For general illumination flaming arc-lamps are provided and for localized lighting and light at the machines incandescent lamps are employed. There are in all 500 flaming-arc lamps, and 23,000 incandescent lamps, one half of which are tungsten. On the assembling floors, where particularly good light is necessary 100-watt tungsten lamps, equipped with intensive steel-enameled reflectors, are used. Holophane material is used throughout the factory and offices.



POWER HOUSE OF THE FLINT POWER SYNDICATE.

Some idea of the amount of floor space which it was necessary to illuminate may be gained from the fact that a figure of 2,275,000 watts is given as the power used for illumination, on the basis of one watt per square foot of floor surface.

All of the detail supplies of this thoroughly modern plant, including eighty 13,200-volt cable bells, busbar supports, iron-pipe-size copper-tubing busbars and fifty-four switchboard panels, were supplied by the Electrical Engineers Equipment Co., of Chicago. The work of installation was done by W. C. Kenney, electrical engineer of the Buick Automobile Company. Transformers and motors, as well as the generators of the Flint Power Syndicate are the products of the General Electric Company.

The plant is at present in full operation and is complete with the exception of a few details, which will add to the finished appearance of the installation. Though the Flint power station feeds only those factories in the immediate vicinity it is interesting to note that it is soon to become a part of one of the greatest high-tension systems in the country, the Au Sable. In this system power will be stepped up to 135,000 volts and transmitted a distance of about 150 miles. A total of 35,000 kilowatts will be generated by this installation, power coming from nineteen dams situated along the Au Sable River in Upper Michigan. Of this power 20,000 kilowatts will be taken off at Saginaw and Bay City, the remaining 15,000 going to Flint. The entire system was conceived and designed by J. B. Foote, of Jackson, Mich., who, it will be remembered, also installed the 110,000-volt transmission line of the Grand Rapids-Muskegon Power Company, which was the first line transmitting power at that high voltage. Mr. Foote will be the pioneer in the use of a still higher voltage.

Central Electric Traffic Association.

The monthly meeting of the Central Electric Traffic Association was held on October 19, at the Secor Hotel in Toledo, O. Representatives of the most of the companies included in the organization were present at the meeting which was presided over by A. L. Neereamer, of Indianapolis, chairman of the association. Routine business only was considered. The traffic men present were: F. D. Norviel, Anderson, Ind.; J. H. Crall, Indianapolis, Ind.; W. S. Whitney, Springfield, O.; C. C. Collins, Lima, O.; G. M. Patterson, Kendallville, Ind.; C. T. Chapman, Toledo, O.; C. J. Laney, Findlay, O.; C. N. Hawley, Toledo, O.; C. B. Kleinhaus, Toledo, O.; C. A. Sullivan, Warsaw, Ind.; Mr. Hardy, Ft. Wayne, Ind., H. Murler, Dayton, O., and M. A. G. Jenssen, Toledo, O.

Railroad-Service Complaints in Indiana.

Complaint has been made to the Railroad Commission of Indiana that motormen on lines in that state do not consult their watches and time tables with sufficient frequency and sometimes pass many sidings without noting the time.

Objection has also been made that the conductors do not treat passengers with sufficient politeness.

Notices have been served on all companies in the state recommending steps that should be taken to obviate these difficulties. S.

Electrification of Railways in Chile.

The Government of Chile has had a commission of experts considering the question of electrification of the Government railways. The conclusion reached by the commission is in favor of this change, and it is expected that the Congress will act accordingly.

Damages for Loss of Use of Car.

The Liverpool (England) Corporation recently recovered damages for the loss of use of one of its trolley cars during repair, as well as for the repairs themselves, from the owners of a traction engine which collided with the car and caused the trouble.

Softening Mica.

According to *The Electrical Engineer*, mica can be softened without losing its toughness by heating to a temperature below redness and suddenly cooling in water.

ELECTROSTATICS AND ELECTRIC IMPULSE FORCES.

DR. STEINMETZ'S LECTURE BEFORE JOINT ELECTRICAL MEETING IN CHICAGO.

The present season of joint meetings of the Chicago Section of the American Institute of Electrical Engineers and the Electrical Section of the Western Society of Engineers was opened on the evening of October 19 at Fullerton Hall, Art Institute, Chicago. Chairman J. G. Wray of the Chicago Section and President J. W. Alvord of the Western Society presided in turn, the latter introducing as the speaker of the evening Dr. Charles P. Steinmetz, who lectured on "Electrostatics and Electric Impulse Forces."

This subject has now become extremely important, said Dr. Steinmetz, although it is not a new subject. In fact, it is the oldest branch of electrical science and constitutes almost all that was formerly taught of electricity in our schools and colleges. The old static machines developed fairly high voltages, but little current and power. Early electrical engineers got little help from the old investigators because they used relatively low voltages and large currents. Now, however, we find 20,000-volt underground cables and 110,000-volt overhead lines to be every-day commercial propositions; moreover, these circuits are connected to generators of enormous power, and the electrostatic problems in relation to them are therefore very important.

The electrostatic field is not easy of physical conception, particularly as electrostatics was formerly taught. Mathematical expressions of natural laws are valueless, however, unless accompanied by a physical picture of the phenomena. Magnetic phenomena were made perfectly clear to us by Faraday's conception of lines of force. The magnetic circuit of a generator is extremely complex and entirely incapable of strict mathematical solution without this conception of lines of force. In fact, engineering calculations are nearly all too complex for purely mathematical treatment without physical pictures of what is taking place. The early ideas of magnetic charge, magnetic quantity, etc., have disappeared and been replaced by such terms as magnetic flux reluctance, permeability, etc., that are physically conceivable. But in electrostatics it is not so, as long as the old terms are still used. In place of them it is possible to apply the same idea of lines of force with equal accuracy and much greater clearness.

In considering what goes on in an electric circuit, it is evident that there is a consumption of power in the wires of the circuit, but there is also action set up outside the wires of the circuit, as is shown by a magnetic needle disclosing the presence of a circular magnetic field about the conductor. Moreover, light, movable bodies will place themselves in a radial direction, showing the presence of an electrostatic field. Whereas the magnetic lines of force are concentric circles about the conductor, the electrostatic lines of force are radii diverging in all directions. The strengths of the magnetic and electrostatic fields have no relation to the power in the circuit.

Dr. Steinmetz then showed in detail the similarity of the mathematical expressions for the magnetic and electrostatic fields. This is made more clear by the lines-of-force conception. The flux in the magnetic field is proportional to the inductance and to the current; the flux in the electrostatic field is proportioned to the capacity and potential. Both these fields represent stored energy due to power supplied in establishing them. Akin to the permaneability as related to magnetic flux is the specific capacity in electrostatic flux; the former is unity for air and most materials, except magnetic bodies whose permeability is very high; the specific capacity is unity for air and gases, but solid dielectrics have higher values ranging up to about ten. Corresponding to magnetic ampere turns per unit length are dielectric volts per unit length or voltage gradient.

The magnetic flux tensity can be increased up to a limiting saturation point. The dielectric flux density can be increased up to a limiting value which is the breakdown point or voltage gradient at which the dielectric becomes a conductor. In air this critical point is about 35,000 volts per centimeter. At the critical point air and gases become luminous. Corona is merely air past the electrostatic saturation point. The calculation of corona problems is made theoretically very simple by the conception of electrostatic lines of force. Naturally the constants must be known and these static constants are not yet reliably known. Secondary phenomena influence the distribution and complicate the problem. With the smallest size of conductors for long-distance transmission, about one-eighth inch diameter, corona begins at about 75,000 to 80,000 ovits. Therefore, until the advent of commercial 110,000-volt lines, little trouble was experienced from this cause.

Since the magnetic and electrostatic fields represent stored energy there is a readjustment of these fields at each change of the circuit. In other words, transient phenomena are set up, which are greatest at the opening of the circuit. The magnetic energy stored up is then converted into electrostatic energy and results in oscillations or a standing wave. The stored electrostatic energy, on the other hand, is converted into magnetic energy and produces a traveling wave. In high-voltage transformers, with high inductance and low capacity, opening the circuit sets up a very high voltage and low current; in underground cables, with low inductance and high capacity, there is set up a low voltage and high current. Where a traveling wave passes from one type of circuit to another there is a transformation from current to voltage. In a cable this surging current does no particular harm because it is at a low voltage, but at transformer terminals the voltage is extremely high and may cause a breakdown of the insulation. In fact, at the entrance to all inductances these electric impulses produce a building up of voltage, which, though of low power, may be several times the normal circuit voltage. In high-tension underground cables there are always present high-frequency waves as on the ocean. The same is true of long-distance overhead lines, but in these the resistance is relatively high and therefore the damping effect on these waves is much greater.

Electrical Exports for August.

The Bureau of Statistics of the Department of Commerce and Labor, Washington, D. C., has issued its monthly summary of imports and exports of the United States for the month of August.

This shows that the figures for electrical exports are quite gratifying, since the high values of the preceding months are practically maintained. As compared with last year there is an increase of nearly fifty per cent in both electrical appliances and machinery. In fact, the indications of the first eight months of this year are that 1910 will show a full return of the high tide of electrical exports of three years ago.

The comparative monthly data are as follows:

	August, 1910	August, 1909	July 1910
Electrical—			
Appliances	$ 852,958	$ 590,864	$ 839,059
Machinery	708,160	448,976	745,419
Total	$1,561,118	$1,039,840	$1,584,478

Electrical Manufacturers' Club.

The Electrical Manufacturers' Club, which has always met at Hot Springs, Va., changed its location this year and met on October 15 at the Hotel Aspinwall, Lenox, Mass. This was the annual meeting, and was largely attended, the usual routine work being put through.

At the election, which was held at this meeting, the following officers were placed in nomination and unanimously elected to serve for the ensuing year:

President, B. M. Downs, Brookfield Glass Company, New York City.

Vice-president, A. H. Pease, Hart & Hegeman Manufacturing Company, Hartford, Conn.

Secretary, Walter Cary, Westinghouse Lamp Company, New York City.

Treasurer, Herbert Sinclair, Star Porcelain Company, Trenton, N. J.

November Joint Electrical Meeting in Chicago.

At the next joint meeting of the Chicago Section of the American Institute of Electrical Engineers and the Electrical Section of the Western Society of Engineers to be held on Wednesday evening, November 23, Dr. Ernst J. Berg, professor of electrical engineering at the University of Illinois, will present a paper entitled the "Surging of Synchronous Machines."

Chicago Automatic Telephone System.

The Illinois Tunnel Company, of Chicago, is wiring its automatic system and installing its switchboard equipment and it is expected that the system will be in partial operation by January. When the installation of telephones begins the company will install 400 to 500 daily. There will, it is said, be 30,000 telephones in service, or 10,000 more than the ordinance requires, by June, 1911.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS.

SIXTH ANNUAL MEETING AT OMAHA, NEB., OCTOBER 11, 12 AND 13.

The sixth annual meeting of the Western Association of Electrical Inspectors took place at Omaha, Neb., on October 11, 12 and 13 last. Headquarters were chosen at the Rome Hotel.

TUESDAY MORNING SESSION.

President Fred G. Dustin called the first session to order on Wednesday, October 11, at 10:15 a. m. H. B. Fleharty, representing Mayor James C. Dahlman, in the latter's unavoidable absence, gave a cordial address of welcome. President Dustin replied, and after the roll call, proceeded to deliver his annual address, Second Vice-President H. G. Young, of Streator, Ill., occupying the chair meanwhile.

PRESIDENT'S ADDRESS.

President Dustin, while stating that the Association had every reason to believe that the Code Committee is largely influenced by the Association's recommendations, based as they are on broad, practical experience, said that this matter of Code changes is not so important as members of the Association formerly believed, since the duties of the Association should be administrative rather than legislative. He noted with satisfaction the action of several of the states which had adopted legislation protecting the public from incompetent electricians, and said this movement should receive the hearty support of the Association.

In the report of the Executive Committee, presented by Secretary William S. Boyd, in the absence of J. H. Montgomery, chairman of this committee, it was stated that sixteen new members had been admitted since the last report was prepared. The report was accepted, as was also that of the secretary, which followed.

Secretary Boyd, at the request of a member, spoke on the federation idea which had been previously mooted. He thought a national organization was impracticable, but favored federation or co-operation with similar organizations.

The president appointed a Nominating Committee, as follows: H. E. Bloomer (chairman), E. W. Adkins, Dana Pierce.

Secretary William S. Boyd read the report of the Committee on Uniformity in Rulings.

UNIFORMITY IN RULINGS.

The duty of the Committee on Uniformity of Rulings is to direct the work of the Association in behalf of a more uniform interpretation of the National Electrical Code. It is necessary for members of the Association to make inquiry regarding proper interpretation of rules before the committee can take any action and as no such inquiries were received the chairman had no report to make. He, however, spoke of the high standard that is being maintained in the west by the electrical inspectors and cautioned the Association against being too eager to attain perfection in the matter of electrical wiring until more assurance is given that the people served are ready for the benefits to be derived.

On motion of Waldemar Michaelson this was accepted and placed on file.

H. E. Bloomer read the report of the Committee on the National Electrical Code. The various rules were read and discussed *seriatim*, and, with various amendments, adopted.

Waldemar Michaelson read the report of the Committee on Outside Wiring.

OUTSIDE WIRING.

The committee recommended that a system be evolved by which a joint occupancy of pole lines would be made possible in cities and towns. The difficulty about making an arrangement of the expense to be borne by the different companies had been worked out in Chicago, and it was suggested that the Association could work out such a scheme for others. The committee stated that it was almost an impossibility to prescribe safe methods for pole-line construction. There were two dangers, (1) to the public, (2) to the men working on the pole lines. The first could reasonably be safeguarded, whereas, in the second, the very nature of pole-line construction constituted working on it a dangerous occupation, and a great many accidents were directly attributable to carelessness on the part of the workmen. It seemed hard to make the insurance people and others realize that the outside construction has just as much to do with the safety of the inside wiring as has the outside wiring itself. It was necessary to look to state and interstate regulation of outside wiring to make it as safe as pole-line construction can be. After all, the safest plan is to abandon pole-line construction and go underground. St. Paul has 26,000-volt lines underground, and Montreal (said Mr. Bennett, interposing) 55,000-volt lines.

Mr. Bennett, of Montreal, stated that the legislature of the Province of Quebec at its last session gave the City of Montreal authority to oblige all operating companies to lay their wires underground within a period not exceeding five years. Some of the larger companies already had voltages as high as 55,000 volts in vitrified clay ducts, a construction which was giving entire satisfaction. Stranded, insulated, lead-covered single conductors were used, he said, one in each duct.

Mr. Varnam said that in St. Paul there were 26,000-volt lines in vitrified conduit, with three wires under the one sheathing.

Mr. Martin questioned the accuracy of Mr. Bennett's last statement, and Mr. Bennett promised to look the matter up further.

The report was adopted and a motion to adjourn until 2:00 p. m. was passed.

TUESDAY AFTERNOON SESSION.

V. H. Tousley opened the afternoon session with the report of the Committee on Theater Wiring and Show Equipment. The report was read and discussed *seriatim*. An abstract of the report follows:

THEATER WIRING AND SHOW EQUIPMENT.

The work of the Committee on Theater Wiring and Show Equipment has had mainly to do with suggested changes in the rules covering theater wiring and with consideration of the subject of notification of members with reference to the electrical equipment carried with traveling shows. The committee reported that the code rules being practically new while covering the subject matter in a thorough manner present opportunities for improvement and the committee has gone over numerous suggestions regarding changes and additions and submitted a number of pertinent changes. Summarizing, the committee made the following suggestions: Each city to notify the general head in the following cases: Where apparatus is condemned and not repaired; where apparatus has deteriorated and liable at any time to become unfit for use; where defects are found and where such defects are corrected but liable to again appear; where some special defect has been noted which might escape general inspection; where any piece of apparatus has proved especially defective.

President Dustin explained that the Code Committee will consider the matters in the report later.

In the course of the discussion a motion was adopted to recommend the making of specifications on the design of stage plugs and receptacles, in order to secure a uniformity which seemed to be lacking at present. This, with some other recommendations, was referred to the Theater Wiring Committee of the National Association.

The report of the Committee on Construction and Installation of Electric Signs was read by Emil Anderson.

CONSTRUCTION AND INSTALLATION OF ELECTRIC SIGNS.

The report of the Committee on the Construction and Installation of Electric Signs covered a number of replies received in answer to requests for opinions sent out by the secretary. In view of the opinions expressed by those answering, the committee made several recommendations regarding the construction and installation of electric signs, among which may be mentioned the following: The use of approved rubber-covered wire supported on porcelain; the exclusion of combustible material from the sign structure; signs should be thoroughly weather proofed to keep wiring and connections dry; series-multiple and multiple-series wiring may be permitted; metal shells of exposed sockets and receptacles should be of copper; some method of weather proofing around sockets to prevent moisture from entering receptacle would be desirable; and low-voltage transformers may

be placed inside of buildings if properly installed.

The discussion of the report was taken up by sections. A majority vote of the members present showed that it was not the sentiment of the Association to require noncombustible material to be used exclusively in signs. Only one member, Mr. Canada, knew of fires taking place through the use of combustible material in signs. Three instances of this had come under his notice in two years.

Fergus P. McGough read the report of the Committee on Show Window and Display Lighting.

SHOW WINDOW AND DISPLAY LIGHTING.

The report of the Committee on Show Window and Display Lighting emphasized the importance of exercising strict supervision over the installation of electric wiring and lights used in connection with Christmas decorations and displays. A detail list of conditions liable to result in accidents is given and inspectors are cautioned to exercise especial care in seeing that they are prevented. The report also suggests a reading notice that is suitable to be given to the daily press for publication before Christmas, advocating a "sane Christmas" as regards electrical wiring, etc. A form letter bearing on this subject, which is to be sent to all inspectors in the Association, was also embodied in the report.

Mr. Bennett stated that he had been one of the fortunate ones to receive copies of the letters drafted by Mr. McGough and his confreres, and that they had assisted him materially in reducing fire losses.

The report was adopted.

In the absence of Thomas D. McColl, chairman of the Committee on Instructions to the Public Concerning the Safe Operation and Maintenance of Electrical Wiring and Apparatus, the report of this committee was presented by Mr. Long. The report was accepted.

The report of the Committee on Underground Systems was presented by Hugh T. Wreaks.

UNDERGROUND SYSTEMS.

The report cited the report of the New York City Commission on the control of underground systems, to the effect that a separate holding company was the best method, this company leasing the conduits to the various electric light companies. The committee recommended that underground systems be recommended for cities of 100,000 population or more. Mr. Wreaks cited the opinion of the secretary of a certain electrical association that where conduits were considered advisable in congested districts they could be run through the main and congested thoroughfares, that for service they could be tapped to pole lines in alleys or in backyards, and that as the business increased to warrant the introduction of the subways all over the town, the matter could be accomplished as a process of gradual development.

The President stated that in compliance with a request by Mr. Wreaks, the work of the committee will be continued.

Secretary Boyd moved that in response to an invitation by the Chicago Chamber of Commerce, the Executive Committee take up the matter of appointing delegates to attend the International Municipal Congress and Exposition to be held in Chicago in September, 1911.

The motion was passed and the meeting adjourned.

In the evening an informal dinner to members was given by the Omaha Electrical Club.

WEDNESDAY MORNING SESSION.

Lewis G. Martin, engineer with the Okonite Company, read a paper on "Rubber-Covered Wire." An abstract follows:

RUBBER-COVERED WIRE.

This paper opens with an appeal to the electrical inspectors to realize the importance of the subject of rubber-covered wires. Attention is called to the fact that the number of buildings being wired with high-grade rubber-covered wire is increasing in proportion to the increased experience of architects and consulting engineers with the lower grades of wire and cable. The author strongly advocates a thirty per cent pure dry fine Para rubber and suitable dry mineral-matter compound for insulation. The paper then proposes methods for determining the proper specifications to insure the securing of reliable and enduring rubber insulation. The first thing is to define in a general way what the insulating compound should consist of, how it shall be treated and what properties it must contain. The paper advocates that the insulating compound shall be made exclusively from pure Para rubber, solid waxy hydrocarbons, suitable mineral-matter and sulphur. The author advances many convincing arguments why Para rubber should be specified, chief of which is the assertion that no other rubber can compare with Para for imparting life, strength and durability to the compound in which it is used. The next consideration discussed is how to determine that the compound required is furnished. In this connection first in importance comes the chemical analysis, and having specified what the compound shall consist of the author holds that it is in order to specify that the compound shall show, on analysis, freedom from all foreign matter, not less than thirty per cent of pure dry fine Para rubber, not more than four per cent of solid waxy hydrocarbons, not more than seven-tenths of one per cent of free sulphur, and not more than 2.65 per cent of total sulphur in any form. Next in order comes the voltage test to discover imperfections, if any. The paper points out that it is neither feasible nor good engineering practice to subject a wire built for 500 volts or less to a potential test of several thousand volts. The last provision of the specification pertains to the insulation resistance, or, as it is commonly called, the megohm test. Megohm tests should be made when the conductor is covered with the vulcanized compound, and before the application of tape, braid or other covering. Tests should be made after at least thirty-six hours' submersion in water and while still immersed. The insulation test should follow the voltage test, should be made with a battery of suitable electromotive-force and the reading taken after one minute's electrification. The author presented a table which should be followed in insulation tests. An actual test which he conducted gave the following results: Ordinary code wire, 150 megohms per mile; intermediate, 500 megohms per mile; thirty per cent of rubber, 1,600 megohms per mile; and thirty per cent fine Para, 3,000 megohms per mile.

After the reading of his paper, Mr. Martin spoke on some things he had learned last winter on a tour of inspection made to discover what was the matter with the electrical installation, as far as the wire was concerned, of a large railroad. This trip impressed upon him how even the best can be spoiled by improper handling. He went on to tell of an article which appeared in the September issue of *The Signal Engineer* on the handling of wire, and recommended his hearers to obtain a copy of the article. He said that the joint is usually the weakest part of an insulation when if anything it should be the strongest, both mechanically and electrically. He had had a pamphlet made up on the proper method of jointing of rubber-wire cable. Copies of this were distributed around to those present.

Replying to a question by Secretary Boyd, Mr. Martin stated that rubber is better than paper as an insulation for cables, provided proper materials are used and suitable care exercised in the vulcanization.

Mr. Pierce said it was possible to produce rubber-covered wire which would satisfy an insulation test and yet be pretty poor wire. He said suitable specifications would shortly be submitted to cover this and other points.

Mr. Wreaks said that with the manufacturers the question was not wholly one of cost but of specifications and of inspection under those specications.

The president proposed a rising vote of thanks to Mr. Martin, which was unanimously accorded.

A paper on "The Influence of Electrical Inspection on the Operation of the Telephone System," by A. S. Rogers, plant engineer, Nebraska Telephone Company, was not read, Mr. Rogers being called away on account of the serious illness and subsequent death of his mother. The paper will be distributed later by mail.

John A. Rhine, assistant city attorney of Omaha, read a paper entitled "The Legal and Ethical Responsibility of the Electrical Inspector," which was

stated by President Dustin to be "the most valuable paper to the inspectors that has ever been presented to the Association," a remark which seemed to be approved by the assemblage judging by the applause which greeted it. A motion was carried to the effect that a copy of the paper be sent to each member, and a rising vote of thanks was tendered to the author. An abstract of the paper follows:

LEGAL AND ETHICAL RESPONSIBILITY OF THE ELECTRICAL INSPECTOR.

This paper treats at some length the duties of the electrical inspector and points out what his attitude should be in all instances where the dignity of his office is concerned. It mentions numerous instances where legal questions arose and quotes a number of court rulings in this connection. It is shown that the ethical responsibilities of the electrical inspector embrace a far wider scope and cover a far larger field than do the responsibilities imposed by law. To summarize these responsibilities, they require him to be competent, impartial, unbiased, firm, diligent in enforcing regulations and courteous to those with whom he deals. In a word they require him to be square with himself and with his fellow men, zealous in the protection of the interests of his employer and faithful to those who repose their trust in him.

T. J. Byrnes, chief electrician of the Cudahy Packing Company, read a paper on "Packing-House Wiring." An abstract follows:

PACKING-HOUSE WIRING.

The author stated that open (knob-and-tube) wiring is found to give much better results than conduit in the tank, glue, salt-storage and casing rooms, owing to the corrosive effects on the conduit of the vapors in these rooms. In fact, corrosion is the principal trouble in all packing houses, and a wooden switch cabinet with glass windows and a gravity-closing door has been largely adopted to protect the switches and fuse blocks. An eight or sixteen-candle power lamp in the cabinet keeps out the dampness and acts further as a pilot lamp for locating the box in the dark. Conduit drainage is important in the damp places and the stopping of air circulation due to temperature gradients between rooms is also advisable. The placing of conduit in concrete floors seems to be a good solution of the difficulty arising from excessive dampness and consequent corrosion.

Secretary Boyd asked if the fact of laying conduits in concrete (thereby requiring the outlets to be more or less fixed) caused any embarrassment because of the fact that lights may be frequently changed as to location.

Replying, Mr. Byrnes said that as a matter of fact, with concrete construction, the machines to a certain extent have to be set according to the lights. Sometimes, however, it was necessary to chip out the concrete alongside the box and open the conduit to a point where a light was to be suspended.

Answering a question by Mr. Bennett, Mr. Byrnes said the cabinet is a plain wooden affair with a window on each side and lined with asbestos. The cut-outs are placed on the asbestos, and the lamp on the inside keeps the box thoroughly dry.

Replying to President Dustin, Mr. Byrnes said that weatherproof paint is used to keep moisture from the box. He extended an invitation to the members to visit his plant.

Mr. Bennett asked what was the best construction for a very cold cold-storage room, temperature about zero.

Mr. Byrnes said the only trouble experienced is in going from a cold room to a warmer room. The method of construction is to lock the pipe at the wall line with pitch or something of the sort, and fill the pipe with pitch at the wall line. This is to stop the air circulation.

Replying to an inquiry by Mr. Boyd, Mr. Byrnes said that the insulation of a joint is made by pealing back the cloth covering a half inch or so tapering down to the point of the wire, and then soldering. There is an Okonite rubber tip, which comes up to the level of the rubber insulation. Friction tape is then put on and taken back on each side of the rubber. It is finally painted with a P. G. compound or W. & P. insulating. By this treatment practically no trouble is experienced with the joints.

Mr. Michaelson then announced that at 2:00 p. m. there would be automobiles at the hotel to take the members about the city.

A rising vote of thanks was given to Mr. Byrnes.

R. E. Campbell, representing the National Electric Lamp Association, Cleveland, Ohio, delivered an address on "The History and Development of the Incandescent Lamp Industry." Mr. Campbell gave a condensed description of the manufacture of carbon, Gem, tantalum and Mazda lamps outlining the improvements which have been made and pointing out some of the peculiarities of the processes involved. He spoke particularly of the low-voltage metal-filament lamp and its applications in electric signs.

At the close of his paper the author extended the members an invitation to visit the plant of the National Electric Lamp Association at any time. A rising vote of thanks was accorded Mr. Campbell for his paper.

Mr. Michaelson announced that the members were invited to be present at a Dutch lunch to be held in the Rome Hotel Vineyard Room, the regular luncheon of the Omaha Electrical Club, whereupon the meeting adjourned.

WEDNESDAY EVENING SESSION.

At the Wednesday evening session, which was called to order at 7:50 p. m., the programme consisted of an informal discussion of "Difficulties Arising in Electrical Inspection Work." Many practical questions were propounded and discussed.

THURSDAY MORNING SESSION.

The Thursday morning session opened at 9:50 a. m. with the reading of a number of letters by Secretary Boyd. These were referred mostly to the Executive Committee.

In the absence of Charles W. Arrack, L. M. Coleman presented the report of the Committee on Installation and Operation of Induction Motors.

INDUCTION MOTORS.

The report made the following recommendations: (1) That alternating-current motors must be provided with no-voltage release devices when such motors would require a starting mechanism, as several manufacturers are now furnishing with their starters; also that the main-line service for high-tension systems within buildings should be protected by main fuses and automatic switch. The circuit-breaker should be provided with both overload and no-voltage release. (2) That all alternating-current motors except repulsion-type single-phase and polyphase motors with internal or external resistance rated at one horsepower or over must be provided with starting and running fuses, the running fuse not to exceed fifty per cent in size over the full-load current. (3) That all motors of 7.5 horsepower and over must have approved starting devices. (4) That polyphase motors requiring running fuses are to be wired up to such fuses to carry 250 per cent of full-load current. (5) That single-phase motors requiring running fuses must be wired up to these fuses to carry 225 per cent of full-load current. (6) That all motors having running fuses must be wired beyond such fuses for not less than 125 per cent of full-load current. (7) That all alternating-current motors of a quarter horsepower or over must be operated on a separate circuit.

Mr. Windsor stated that the most important of several reasons why a no-voltage release is necessary is the fact that unless high-tension installation is prosecuted in that way, the customer has absolutely no hope of saving his motors in case of a brief interruption on the part of the service.

Mr. Michaelson saw no reason why a no-load release is not needed for an alternating-current motor just as much as a direct-current motor that needs a starting device.

The first recommendation was adopted.

After some discussion on the second recommendation, Mr. Varnam moved

"That it is the sense of this Association that two sets of fuses would be desirable." This motion was carried.

In the third recommendation the horsepower size was changed from 7.5 to 5 on an amendment by Emil Anderson.

Mr. Bloomer asked if the members had any trouble in determining what is considered a fair normal running load. He showed the different practices adopted by manufacturers in this respect. In some tests at Milwaukee, it was shown that the power-factor and the efficiency (of some motors under test) brought the current up to considerably higher than that marked on the nameplate. He thought there ought to be some rule to calculate normal running load, or, failing this, the various sizes of wire for the different sizes of machines should be decided upon.

Mr. Tousley cited the Commonwealth Edison Company of Chicago to show that little or no trouble had been caused, in that company's experience, in burning out of a motor due to overfusing, at least not enough to warrant additional expense in the installation of fuses or in the starting apparatus. He went on to say that in his experience the wires are practically overfused according to the Underwriters' Schedule. He allowed 150 per cent wire, 50 per cent overfusing of that, which gives 225 per cent of the normal current, and the fuse itself is about 80 per cent capacity; it allows considerable overfusing of the wires.

Mr. Boyd thought it unwise to permit the overfusing of wires. He had always required that fuses shall be proportioned to protect the conductor.

Mr. Bennett moved the rejection of the paragraph. The motion was carried.

The other recommendations met with no opposition and were passed.

A motion was carried to the effect that the National Code Committee be requested to amplify Rule 8, Section B, paragraph 3.

The report of the Committee on Electrical Hoisting Apparatus was not presented.

The report of the Committee on Laws and Ordinances was discussed at length.

The report of the Committee on Architects' Specifications and that of the Committee on Signal Systems were filed and accepted without discussion.

Mr. Michaelson announced plans for inspection of theater wiring during the noon recess, and the meeting adjourned.

THURSDAY AFTERNOON SESSION.

The report of the Committee on Public Safety was presented in abstract with running commentaries by W. J. Canada. This committee has been working for three years and the report comprised largely a reiteration of recommendations for the removal of hazards to life, which are also hazards from the fire standpoint, but which are not covered particularly in rules now in force under the Code.

After some discussion and announcements from the chair concerning the theater party for the evening, President Dustin announced the report of the Nominating Committee to which Mr. Bennett had been appointed in place of Mr. Adkins, who had had to return home.

The recommendations were:

For President, V. H. Tousley.

For Vice-Presidents, W. J Canada and James Bennett.

For Secretary-Treasurer, W. S. Boyd.

For Executive Committee, W. Michaelson (chairman), H. M. Maxwell, F. G. Dustin, W. E. Flickinger, J. H. Fenton, and J. B. Dempster.

President-Elect Tousley proposed a vote of thanks to Mr. Michaelson and the City of Omaha. This was carried unanimously, whereupon the Sergeant at Arms conducted Mr. Tousley to the chair for an impromptu address, after which Retiring-President Dustin declared the meeting adjourned *sine die*.

A New Geographic Section of the National Electric Light Association.

At Atlanta, Ga., on October 20 and 21, steps were taken by a number of central-station companies in the state resulting in the formation of a new geographic section of the National Electric Light Association. This action was due to the initiative of John S. Bleecker, who, with the assistance of W. R. Collier, has been canvassing the state actively ever since the St. Louis convention. The meetings were held at the office of the Georgia Railway and Light Company, and after thorough discussion on the first day, committees were appointed to draw up a constitution and to nominate a ticket of officers for the proposed body. At the adjourned meeting on Friday, October 21, both committees presented their reports. The constitution adopted follows closely the lines of that of the New England Section and place the voting power in the hands of the operating companies of the state, while recognizing all the other classes of membership now known in the National organization, which at the present time has in membership in Georgia, eleven Class A members and twenty-five Class B members, as well as a few scattering memberships among representatives of the manufacturing and supply houses. The section thus starts out with a good nucleus, and it is believed that the membership can be doubled or even trebled during the coming year.

The following officers were unanimously elected: President, John S. Bleecker, Columbus; vice-president, W. R. Collier, Atlanta; executive committee, J. J. Cagney, Macon; R. P. Mayo, Augusta; Burdett Loomis, Jr., Waycross; secretary-treasurer, H. M. Corse, Columbus. The whole meeting was characterized by enthusiasm and a conviction was frequently expressed that the Georgia Section could be made one of the largest and most influential in the Association.

The proceedings of the convention were most agreeably varied by entertainment on the part of the local electric people. On Thursday a luncheon was given the delegates by the manufacturing and supply concerns, under the auspices of W. M. Stearns, of the General Electric Company, and on Friday luncheon was given to the whole convention at the Capital City Club by the Georgia Railway and Light Company, whose officers, President P. S. Arkwright, General Manager G. W. Brine and W. R. Collier were indefatigable in their attentions and courtesies. During Friday afternoon the party was also given by the Georgia Company an automobile trip around the city to the various plants and other points of interest.

The National Electric Light Association was represented throughout the convention by T. C. Martin, secretary, who supplied data as to the constitution, methods and practice of the other sections already affiliated.

Locks Lighted by Electricity.

The Banavie locks on the Caledonian Canal in Scotland are now lighted by electricity.

ELECTRIC VEHICLE ASSOCIATION OF AMERICA.

FIRST ANNUAL CONVENTION AT NEW YORK CITY, OCTOBER 18, 1910.

The first annual convention of the Electric Vehicle Association of America, held at the concert hall of Madison Square Garden, Tuesday, October 18, was from every point of view a decided success. Over 250 members were registered, the list including men prominent in central-station work, electric vehicle manufacture, and vehicle users.

The convention was first called to order by President W. H. Blood, Jr., who after a few preliminary remarks, read the presidential address. This address, in part, follows:

PRESIDENTIAL ADDRESS.

The immediate problem to be overcome is the common prejudice of the public against the electric vehicle. Many people do not realize its progress or the progress of the electric battery to which manufacturers are now giving more publicity. Central-station managers all stand ready to assist in introducing electric vehicles and have already done a great deal. Seeing the need of an organization to "boost" the electrics, the movement for the present association started in Boston. The New England section was organized in 1908 and the national body was incorporated in 1910, with a membership of twenty-nine. The total membership is now 120. The Pacific Coast Electric Vehicle Association and a similar body in Chicago now seek to affiliate. Such a great national body as would result would be able to do much good. Standards could be adopted as to motors, chassis, etc., and gauges could be made uniform. An electric "Blue Book," giving the names of all charging stations might be published. Batteries might eventually be owned by the association and simply loaned to customers as a bottle or gasoline can is. Discharged batteries could be turned in and recharged ones put on the machine. The present price of electric vehicles is high, but they are going down in price as are the batteries. It is the duty of the association to bring the public and the vehicle manufacturer together, to the benefit of all parties concerned.

In expressing his appreciation of Mr. Blood's address, Arthur Williams suggested that it should be printed and widely circulated among central stations, electric vehicle manufacturers and others interested. A motion to appoint a committee of three to carry out the purpose of this suggestion was passed.

A paper on "Problems Involved in Advancing the Use of Electric Vehicles" was then read by W. P. Kennedy. This paper is given here in abstracted form:

ADVANCING THE ELECTRIC VEHICLE.

In treating his subject, Mr. Kennedy first gave a résumé of the history of the vehicle and of wheels, following this by remarks on the development of self propulsion. The application of electricity to vehicles began tentatively in 1880 and in 1895 the manufacture of electric vehicles was carried on quite extensively. Considerable patience was, and still is, necessary to introduce electric vehicles in new fields, but there is no reason to doubt the possibilities of their extended employment. The objections to changing from time-honored horse vehicles can only be overcome by good salesmanship and superior mentality. The flexibility of electric propulsion was touched upon with a number of other advantages. The problem of securing competent designers, who will consider commercial points as well as technical ones is extremely difficult. No less difficult is the question of securing salesmen of sufficient ability. In the campaign of advancing the use of electric vehicles the highest order of salesman is necessary and all should sink petty points and aid in the general campaign.

In view of the completeness of this paper there was no discussion and the reading of the next paper followed immediately. This paper, entitled "Recent Electric Automobile Performances With the Edison Battery," was presented by Frank L. Dyer, of Orange, N. J. Mr. Dyer's paper was illustrated with numerous stereopticon views showing types of cars used, maps of region covered in tests and some of the roads and hills encountered on them. A series of one-day automobile trips made by Thomas Edison, each trip calling for from eighty to one hundred miles on a single charge of the new Edison storage cells, was described. Following these tests descriptions were given of a week's test trip through Pennsylvania (a total mileage of 489), and a 1,000-mile tour from New York. Both tours went through various points in New England, and both were highly satisfactory.

These various tests demonstrated that electric vehicles were by no means limited to city streets, but well capable of making country roads, climbing hills, etc.

Preceding this paper were shown moving pictures which amusingly but convincingly demonstrated the advantage in safety, convenience and ease of operation of the electrically driven car, as compared with the gasoline or horse-driven vehicle. Before displaying these moving pictures Mr. Dyer remarked on the advantages of moving pictures as a new and effective method of advertising the electric car.

L. A. Ferguson of Chicago then presented a paper on "The Responsibility of the Central Station to the Electric Vehicle Industry." An abstract of Mr. Ferguson's paper, dealing with the most important points, follows:

RELATION OF CENTRAL STATION TO ELECTRIC VEHICLE INDUSTRY.

This paper points out in an excellent manner the relationship of the central station to the electric vehicle industry as being, in a way, analogous to that of the consulting engineer to his client. Considerable space is devoted to pointing out the importance of a central station educating the new user and garage owner in battery charging. Poor battery charging is responsible for a majority of the complaints against the electric vehicle. In all matters the central-station company should give advice and offer suggestions, not only when appealed to but at all times the company's engineers should be ready to assist the user. All of this effort will be rewarded by the increased revenue produced by an "electric vehicle load." The paper embodies a report of an investigation of the actual cost of operation of six modern design 3,100-pound capacity electric delivery wagons over an average period of one year. The figures were taken from the statistical report of the Commonwealth Edison Company, Chicago, and show actual costs of operation, including electrical energy at four cents per kilowatt-hour, supplies, tires, battery and all other repairs. Data relating to pleasure vehicles were also presented and in this connection attention is called to the importance of central stations having reliable information on the cost of operation of electric vehicles to present to prospective customers.

Following Mr. Ferguson, Day Baker, of Boston, Mass., presented a paper under the title, "Various Applications of the Electric Vehicle." This was illustrated by a great number of stereopticon slides, most of which were self-explanatory. These views were illustrative of the development of the electric vehicle from the very oldest type to the newest model. Both the commercial and the pleasure types were treated in this way.

Owing to the extended morning session and in order to give sufficient time for thorough discussions during the later sessions, J. T. Hutchings, of Rochester, N. Y., read his paper in a very abbreviated form. Mr. Hutchings' paper, entitled "The Electric Vehicle in Heavy Trucking Service," brought out the advantage of the great simplicity of operation of electrics, and the consequent ease in securing operators.

After the reading of Mr. Hutchings' paper the session adjourned to partake of a luncheon given to the Association by the New York Edison Company.

AFTERNOON SESSION.

The afternoon session was called to order at three o'clock, the first paper read being one by Bruce Ford of Philadelphia, on "The Electric Vehicle Battery." Mr. Ford's paper follows in part:

THE ELECTRIC VEHICLE BATTERY.

In this paper Mr. Ford explains the nature of the storage battery, dealing with the lead-

sulphuric-acid and nickel-alkali-iron types. As the latter has a high capacity per unit weight it is especially attractive where a high mileage is required per unit charge. High internal resistance and high initial cost are among its disadvantages. In the present standard type of cells the capacity per pound can be varied by furnishing plates of different thickness. The thicker plate has the longer life. The mileage obtainable with each discharge is greater with the thinner plates. As the life of a battery depends almost wholly on its mechanical ability to stand repeated charge and discharge there can still be much progress in prolonging this life. The Electric Storage Battery Company employs means for holding the active material, which has resulted in materially lengthening the life of the battery.

Following this account, S. C. Harris presented his paper on the "Proper and Practical Care of Electrical Vehicle Batteries."

THE CARE OF BATTERIES.

The construction of the lead battery is taken up in considerable detail dealing with the tray, manner of arranging cells in the tray, insulation between the rows of cells, kind of contacts used and manner of assembling the cell. The cells should be filled with 1,200 acid, and the charging rate should be about one ampere per positive plate. The temperature should not be allowed to rise more than 100° F. One cell should be used as a pilot cell. When the forming charge has been completed one or two discharges should be taken to determine the capacity. After the battery is put into service care should be taken not to overcharge or overdischarge and to use pure water, acid, etc. Manufacturers recommend charging at full rate until maximum voltage is reached and at half rate until reached again, but this is often difficult to accomplish. Charging by the ampere-hour meter method is simpler and is attended with good results. Care should be taken not to overcharge or overthe cells are not leaking or slopping over. To make cells last their full life the route a vehicle travels should be short enough so as not to require a complete discharge daily. Care should be used by the driver at all times.

F. M. Tait, of Dayton, O., presented in abstracted form his paper on a "Central-station Campaign for Electric Vehicles." The most important points of Mr. Tait's paper are included in the abstract given here.

A CAMPAIGN FOR ELECTRIC VEHICLES.

This paper outlines a number of excellent suggestions for central stations to follow in the campaign for electric vehicle business. The pleasure vehicle is considered first. The paper mentions the conditions in vogue a few years ago which hindered to a great extent the wide use of electric pleasure vehicles. These having been overcome, however, it is incumbent on the central-station companies to extend every effort to develop this fertile field. One suggestion made is for the central stations' vehicle man to keep in close touch with social functions and offer the services of the electric to ladies in transporting them to and from their destination. Another plan is to offer the electric to a doctor, having a large practice—demonstrating to him the ease and convenience of operation. These demonstrations must be followed up, of course, by visits from salesmen. Periodic inspection of electric vehicles in a territory served by a central station is also advocated. Regarding rates the paper states between $25 and $30 per month for the average coupe or victoria as an equitable charge for charging, storing and washing machines. For selling current to public garages the author proposes a rate of four cents per kilowatt-hour, with a minimum charge of $5.00 net per month per charging rheostat connected. Considering the electric truck, the author states that it must be handled along somewhat different lines than the pleasure vehicle. The first and most important step in the campaign for electric trucks is for the central station to own and operate one or two of its own. Next a garage should be equipped with proper facilities for handling the business. Great care should be taken by central stations in the care of all trucks. A plan to interest possible purchasers, outlined, is to tabulate a list of the various business houses using horse-drawn vehicles and offer the services of an electric vehicle in charge of a competent operator, keeping an accurate record of the performance of the electric for comparing. The paper points to the responsibilities that rest on the salesman and emphasizes the importance of employing high-grade men, who are experts in electric vehicle matters. A number of photographs are presented of installations in Dayton and the methods of this company briefly explained. In closing the author suggests that the electric vehicle builders consider the design of a small electric wagon, from 500 to 750 pounds capacity, as he holds that there is a great demand for these "service wagons."

A general discussion of the paper followed, in which Hayden Eames, of Cincinnati, and others took part. Mr. Eames remarked that, although much had been said about the care of batteries, no one had said anything regarding the extent to which they might be abused and yet be successful. He thought it essential for central stations to teach users the importance of letting their batteries alone. To help make use of electric delivery trucks more generally available for long hauls where hills are encountered, R. M. Searle of Rochester suggested that central stations provide a trolley to haul cars up these hills. Mr. Searle also suggested that technological schools should teach electric-vehicle care and operation in their automobile courses.

Mr. Sands of Boston emphasized, in his remarks, the great need of a lighter type of electric vehicle for commercial use. He urged manufacturers to consider this matter. According to Mr. Lund, of Chicago, the charges for battery washing might be reduced by a little thoughtfulness on the part of the customer. High rates are charged by the repair men because the batteries come in at inconvenient times. On the point of light electric delivery wagons, Mr. Lund gave it as his belief that better wagons of this sort, bringing also decreased maintenance charges, would be built. Arthur Williams, referring to Mr. Ferguson's paper, also dwelt on the advantage of electric vehicle-charging business to the central station in preference to furnishing current for elevator service. Mr. Williams also brought out the need of a light vehicle, with light batteries, motors, etc., to cost about $750.

G. M. Graham, of Philadelphia, gave an interesting talk on the "Motor Vehicle Road Tests," which were held by the Philadelphia *North American*. During these trials, in which the vehicles ran from Philadelphia to Atlantic City, the electrics made an excellent showing. Following Mr. Graham, Duncan Curry of New York, in a few brief remarks on the "Proposed Run Under the Auspices of the *New York American*," stated that he had not yet received an entry.

Charles L. Eidlitz then read the last paper of the session, "A Large Modern Garage."

A MODERN GARAGE.

This paper describes the new electric automobile garage of Gimbel Brothers, at New York. The garage is equipped with 595 horsepower in charging equipment and can accommodate ninety vehicles. The building is a two-story, fireproof structure with a frontage of 150 feet by 100 feet in depth. It is equipped with all the latest apparatus on the market and is designed for attaining speed and efficiency in charging, repairing, cleaning, etc.

After a discussion in which Messrs. Mansfield, Smith, Wagner and Turner participated, the convention adjourned.

Electrical Engineers on Inspection Trip.

Twenty-six members of the Ft. Wayne Section of the American Institute of Electric Engineers of Ft. Wayne went to La Fayette, Ind., in a special car over the Ft. Wayne & Wabash Valley Traction line October 11. The start was made from the electric works plant, making the first stop at Delphi to inspect the modern substation of the road at that point. They arrived in La Fayette at 1 o'clock and after dinner spent nearly the entire afternoon inspecting the company's new power house. The trip was an innovation in their course of meetings and the party was well pleased with its trip and entertainment.

Copper Exports.

Exports of copper for the week ended October 20, were 6,696 tons. Exports since the first of the month were 15,762 tons as compared with 17,247 in the same period last year.

WINDING COEFFICIENTS FOR SINGLE-PHASE MOTORS.—III.

BY H. WEICHSEL.

According to what has been said before, it will be a very simple matter to derive the coefficient M for different values of field distribution and different percentage of shortened throw of armature coil. Assume, for instance, that the field distribution is given by the equation

$$By = B \sin y$$

Each coil of the armature winding embraces A per cent of the pole pitch. The coil which lies symmetrical to the center of the pole embraces the lines (see Fig. 26)

$$N_x = 2l \int_{\frac{\pi}{2} - A\frac{\pi}{2}}^{\frac{\pi}{2}} B \sin y \, dy$$

$$= 2 \, l \, B \cos (1 - A) \tfrac{\pi}{2}$$

$$= 2 \, l \, B \sin \frac{\pi A}{2} \qquad (28)$$

The total number of lines per pole is

$$N = 2l \int_{0}^{\frac{\pi}{2}} B \sin y \, dy$$

$$= 2 \, l \, B \qquad (29)$$

Fig. 26

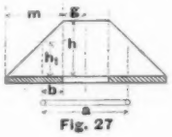


Fig. 27

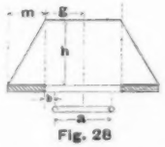


Fig. 28

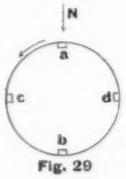


Fig. 29

The coefficient M then is the ratio of N_x to N.

$$M = \frac{Nx}{N} = \sin \frac{\pi A}{2}$$

$A\pi/2$ represents the angle embraced by one armature coil. For full pitch winding $A = 1$ and $M = 1$. Fig. 30 gives the values of this coefficient for different percentage shortened throw and sine-shaped field. In a similar manner it is possible to derive the coefficient M for any other field shape. Assume that we have a trapezoidal field shape as shown in Fig. 27. It will be found that the determination of all values of M requires two different equations depending on whether the coil span is greater than or less than $2\,g$.

Take the first case, where a is greater than $2\,g$, as in Fig. 27.

$$\frac{h_1}{h} = \frac{m-b}{m}$$

$$N_o = m\,h + 2\,g\,h$$

$$N_a = N_o - h_1\,(m-b)$$

$$= N_o - \frac{h}{m}\,(m-b)^2$$

$$M = \frac{N_a}{N_o} = 1 - \frac{(m-b)^2}{m\,(m+2\,g)} \qquad (30)$$

Fig. 28 represents the other case, where a is less than $2\,g$.

$$N_o = m\,h + 2\,g\,h$$

$$N_a = N_o - m\,h - 2\,b\,h$$

$$M = \frac{N_a}{N_o} = 1 - \frac{m+2b}{m+2g} \qquad (31)$$

The coefficients as determined by equations (30) and (31) have been calculated and plotted in Fig. 31.

The coefficients given by the various curves represent practically all the coefficients necessary for calculating the electrical and magnetic constants of a single-phase motor.

A better insight into the use of these curves will be obtained if we give several applications of them. In Fig. 29 is represented a single-phase armature rotating in a field of N maxwells. We will obtain an electromotive force across the brushes c-d, due to rotation in the field N, and an electromotive force of transformation across the brushes a-b. Let us further assume that the field has a sine-shape distribution and the armature has a chord winding, the throw of which is A per cent of the pole pitch. The voltage across a-b will be given by the equation

$$E_t = 2.22\,f_s\,A\,Z\,N\,V\,10^{-8}$$

The value of f_s is given in Fig. 15 for a percentage winding corresponding to A per cent. The equation must contain A because the number of effective conductors is AZ, as previously explained. The voltage across the brushes c-d, due to rotation, will be

$$E_r = \frac{n}{60\sqrt{2}} M\,N\,Z\,P\,10^{-8}$$

as given in Fig. 30. If the rotor rotates in synchronism we get

$$N = \frac{120\,V}{P}$$

and

$$E_r = \sqrt{2}\;V\,M\,N\,Z\,10^{-8}$$

and the ratio of the voltage due to rotation and transformation is

$$\frac{E_r}{E_t} = \frac{\sqrt{2}\;M}{2.22\,f_s\,A}$$

From previous derivations we know further that for a sine-shaped field the following equations are true

$$f_s = \frac{\sin c}{c} = \frac{\sin \frac{\pi A}{2}}{\frac{\pi A}{2}}$$

$$M = \sin \frac{\pi A}{2}$$

$$\frac{E_r}{E_t} = \frac{\sqrt{2}}{2.22}\,\frac{\pi}{2} = 1$$

This equation might be expressed in words as follows: the electromotive force of rotation equals, at synchronism, the electromotive force of transformation if the transformer field has sine-shaped distribution. This law is true for rotors with full-pitch winding, as well as for rotors with chord winding. If, however, the transformer field has not a sine-shape distribution the above law no longer holds true, as will be seen from the following two extreme cases:

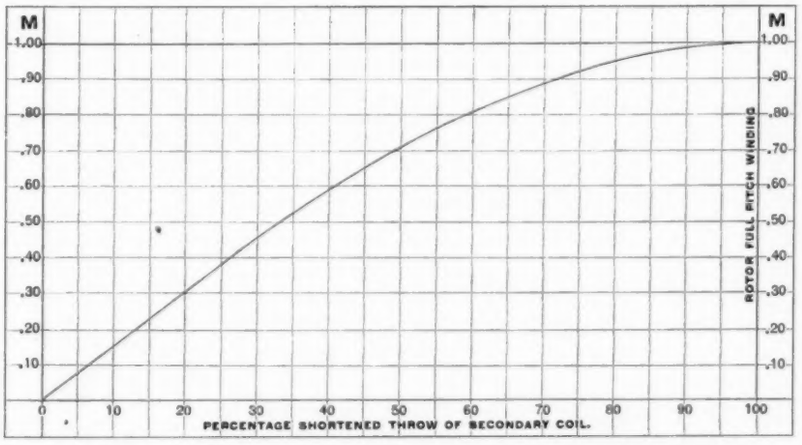


FIG. 30.—CHORD WINDING COEFFICIENT FOR SINE-SHAPED FIELD.

Assume that the field has triangular field distribution and the rotor has ninety per cent pitch winding.

$$A = 0.9 \quad M = 0.99 \quad f_s = 0.73$$

$$\frac{E_r'}{E_t} = \frac{\sqrt{2} \times 0.99}{2.22 \times 0.73 \times 0.9} = 0.96$$

As another example assume that the field has rectangular field distribution and the rotor full-pitch winding.

$$A = 1 \quad M = 1 \quad f_s = 0.5$$

TABLE I. SPREADING COEFFICIENT f_x FOR TRAPEZOIDAL FIELD

$\frac{x}{T}$	PERCENTAGE WINDING.										
	0	10	20	30	40	50	60	70	80	90	100
0	1.000	.996	.986	.968	.945	.915	.880	.836	.785	.730	.666
0.1	1.000	.996	.986	.968	.945	.914	.878	.834	.783	.727	.663
0.2	1.000	.996	.985	.967	.943	.913	.875	.830	.776	.719	.655
0.3	1.000	.996	.985	.966	.941	.905	.867	.819	.764	.706	.643
0.4	1.000	.995	.984	.964	.935	.901	.857	.804	.750	.689	.628
0.5	1.000	.995	.982	.959	.927	.889	.841	.788	.733	.672	.610
0.6	1.000	.994	.978	.952	.912	.870	.820	.769	.710	.651	.590
0.7	1.000	.993	.973	.939	.896	.849	.795	.741	.688	.632	.569
0.8	1.000	.990	.962	.918	.868	.820	.768	.715	.660	.601	.545
0.9	1.000	.982	.939	.890	.840	.792	.737	.685	.630	.578	.522
1.0	1.000	.950	.900	.850	.800	.750	.700	.650	.600	.550	.500

TABLE II. TRANSFORMER-VOLTAGE COEFFICIENT B

$\frac{2c_2}{T}$	PERCENTAGE WINDING OF PRIMARY.										
	0	10	20	30	40	50	60	70	80	90	100
0	1.000	1.020	1.040	1.065	1.093	1.125	1.167	1.220	1.290	1.377	1.500
0.1	.950	1.000	1.030	1.057	1.088	1.120	1.160	1.215	1.284	1.371	1.497
0.2	.900	.957	1.000	1.035	1.070	1.108	1.150	1.200	1.270	1.359	1.480
0.3	.850	.905	.955	1.000	1.041	1.080	1.125	1.180	1.245	1.332	1.454
0.4	.800	.850	.902	.954	1.000	1.044	1.092	1.150	1.215	1.300	1.420
0.5	.750	.807	.853	.903	.951	1.000	1.052	1.105	1.175	1.258	1.374
0.6	.700	.754	.798	.845	.896	.946	1.000	1.058	1.128	1.210	1.320
0.7	.650	.698	.744	.788	.840	.885	.938	1.000	1.070	1.150	1.257
0.8	.600	.642	.686	.733	.776	.825	.875	.932	1.000	1.078	1.180
0.9	.550	.589	.624	.672	.712	.756	.804	.861	.926	1.000	1.097
1.0	.500	.532	.567	.605	.645	.687	.733	.785	.845	.913	1.000

TABLE III. MAGNETIZING-CURRENT COEFFICIENT C_{ab}

$\frac{2c_b}{T}$	PERCENTAGE OF A WINDING										
	0	10	20	30	40	50	60	70	80	90	100
0	10.00	9.53	9.03	8.53	8.03	7.52	7.02	6.52	6.02	5.52	5.02
0.1	9.53	9.35	8.94	8.46	7.97	7.52	7.02	6.51	6.00	5.50	4.98
0.2	9.03	8.94	8.67	8.29	7.85	7.39	6.92	6.44	5.94	5.44	4.93
0.3	8.53	8.46	8.29	8.02	7.64	7.30	6.77	6.31	5.85	5.37	4.86
0.4	8.03	7.97	7.85	7.64	7.35	6.98	6.57	6.16	5.69	5.22	4.74
0.5	7.52	7.52	7.39	7.23	6.98	6.68	6.33	5.91	5.50	5.05	4.63
0.6	7.02	7.02	6.92	6.77	6.57	6.33	6.02	5.65	5.27	4.85	4.42
0.7	6.52	6.51	6.44	6.31	6.16	5.91	5.65	5.35	4.99	4.61	4.19
0.8	6.02	6.00	5.94	5.85	5.69	5.50	5.27	4.99	4.67	4.32	3.94
0.9	5.52	5.50	5.44	5.37	5.22	5.05	4.85	4.61	4.32	4.01	3.66
1.0	5.02	4.98	4.93	4.86	4.74	4.63	4.42	4.19	3.94	3.66	3.34

TABLE IV. TRANSFORMER-CURRENT COEFFICIENT G

$\frac{2c_2}{T}$	PERCENTAGE WINDING OF PRIMARY.										
	0	10	20	30	40	50	60	70	80	90	100
0	1.000	.982	.961	.940	.915	.887	.858	.825	.778	.728	.665
0.1	1.050	1.000	.971	.947	.925	.895	.858	.830	.780	.732	.675
0.2	1.110	1.050	1.000	.970	.939	.903	.870	.832	.785	.740	.683
0.3	1.178	1.105	1.046	1.000	.960	.922	.890	.850	.800	.750	.685
0.4	1.250	1.175	1.106	1.050	1.000	.958	.918	.873	.824	.771	.708
0.5	1.335	1.250	1.175	1.113	1.056	1.000	.955	.906	.855	.800	.730
0.6	1.430	1.340	1.255	1.185	1.120	1.057	1.000	.950	.890	.831	.760
0.7	1.540	1.440	1.350	1.272	1.190	1.128	1.060	1.000	.935	.871	.791
0.8	1.670	1.560	1.465	1.380	1.290	1.210	1.140	1.070	1.000	.927	.845
0.9	1.817	1.700	1.595	1.500	1.405	1.320	1.240	1.165	1.089	1.000	.915
1.0	2.000	1.870	1.760	1.650	1.550	1.450	1.364	1.275	1.185	1.096	1.000

TABLE V. APPARENT-LEAKAGE COEFFICIENT q IN PER CENT

$\frac{2c_2}{T}$	PERCENTAGE WINDING OF PRIMARY.										
	0	10	20	30	40	50	60	70	80	90	100
0	0	3.12	6.25	9.40	12.5	15.4	18.2	20.6	22.5	24.2	25.0
0.1	3.12	0	1.40	4.20	7.00	9.76	12.5	15.2	17.5	19.4	20.5
0.2	6.25	1.40	0	1.10	3.40	5.90	8.30	10.7	12.8	14.7	16.1
0.3	9.40	4.20	1.10	0	0.75	2.60	4.75	6.80	8.75	10.5	12.0
0.4	12.5	7.00	3.40	0.75	0	0.70	2.20	3.90	5.70	7.30	8.30
0.5	15.4	9.76	5.90	2.60	0.70	0	0.60	1.75	3.20	4.40	5.25
0.6	18.2	12.5	8.30	4.75	2.20	0.60	0	0.50	1.30	2.30	3.30
0.7	20.6	15.2	10.7	6.80	3.90	1.75	0.50	0	0.45	1.10	1.90
0.8	22.5	17.5	12.8	8.75	5.70	3.20	1.30	0.45	0	0.30	0.95
0.9	24.2	19.4	14.7	10.5	7.30	4.40	2.30	1.10	0.30	0	0.30
1.0	25.0	20.5	16.1	12.0	8.30	5.25	3.30	1.90	0.95	0.30	0

TABLE VI. LEAKAGE-REACTANCE COEFFICIENT H

$\frac{2c_2}{T}$	PERCENTAGE WINDING OF PRIMARY										
	0	10	20	30	40	50	60	70	80	90	100
0	0	0.28	0.056	0.084	0.111	0.137	0.162	0.184	0.201	0.215	0.222
0.1	0.026	0	0.012	0.035	0.058	0.081	0.104	0.126	0.145	0.161	0.170
0.2	0.048	0.011	0	0.008	0.026	0.045	0.064	0.083	0.099	0.114	0.124
0.3	0.067	0.030	0.008	0	0.005	0.018	0.034	0.048	0.062	0.075	0.085
0.4	0.081	0.046	0.022	0.005	0	0.005	0.014	0.025	0.037	0.047	0.054
0.5	0.091	0.058	0.035	0.015	0.004	0	0.004	0.010	0.019	0.026	0.031
0.6	0.097	0.067	0.044	0.025	0.012	0.003	0	0.003	0.007	0.012	0.018
0.7	0.098	0.072	0.051	0.032	0.018	0.008	0.002	0	0.002	0.005	0.009
0.8	0.093	0.073	0.053	0.036	0.024	0.013	0.005	0.002	0	0.001	0.004
0.9	0.086	0.069	0.52	0.037	0.026	0.016	0.008	0.004	0.001	0	0.001
1.0	0.074	0.061	0.048	0.036	0.025	0.016	0.010	0.006	0.003	0.001	0

TABLE VII. CHORD-WINDING COEFFICIENT M FOR TRAPEZOIDAL FIELD

$\frac{a}{T}$	PERCENTAGE WINDING OF PRIMARY.										
	0	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0
0.1	0.100	0.105	0.111	0.117	0.125	0.134	0.143	0.154	0.166	0.181	0.190
0.2	0.200	0.210	0.222	0.235	0.250	0.267	0.285	0.308	0.333	0.353	0.360
0.3	0.300	0.315	0.333	0.353	0.375	0.400	0.428	0.461	0.490	0.505	0.510
0.4	0.400	0.421	0.445	0.470	0.500	0.534	0.571	0.604	0.625	0.636	0.640
0.5	0.500	0.526	0.555	0.589	0.625	0.667	0.702	0.725	0.740	0.747	0.750
0.6	0.600	0.632	0.667	0.706	0.750	0.787	0.810	0.824	0.833	0.838	0.840
0.7	0.700	0.737	0.778	0.823	0.860	0.880	0.893	0.901	0.906	0.909	0.910
0.8	0.800	0.842	0.889	0.921	0.937	0.947	0.952	0.956	0.958	0.959	0.960
0.9	0.900	0.947	0.972	0.980	0.984	0.987	0.988	0.989	0.990	0.990	0.990
1.0	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

TABLE VIII. VARIOUS COEFFICIENTS

Percentage winding.	K	f	fs	D	C	M
0	0.890	1.000	1.000	0.199	5.02	0
10	0.845	0.982	0.995	0.214	4.68	0.1564
20	0.800	0.962	0.983	0.230	4.34	0.3090
30	0.756	0.940	0.963	0.250	4.00	0.4540
40	0.712	0.915	0.936	0.272	3.67	0.5878
50	0.667	0.889	0.900	0.299	3.34	0.7071
60	0.623	0.857	0.858	0.332	3.01	0.8090
70	0.578	0.820	0.811	0.374	2.67	0.8910
80	0.534	0.776	0.757	0.429	2.33	0.9511
90	0.490	0.727	0.699	0.497	2.01	0.9877
100	0.445	0.666	0.636	0.596	1.675	1.000

$$\frac{E_r}{E_t} = \frac{\sqrt{2}}{2.22 \times 0.5} = 1.275$$

These two examples will show plainly the influence which the field shape and the rotor winding distribution have on the operating characteristics of a single-phase motor.

TABLE IX.

Required	Given	Equation	Curve of Figure Number
Number of Lines	Winding and its Distribution and Current	$N = K\frac{iz}{R}$	9
Number of Lines	Two Windings in Series and Their Distribution and Impressed Voltage	$N = \frac{2.54E(Z_aK_a \pm Z_bK_b) \times 10^8}{V(C_aZ_a^2 \pm C_bZ_b^2 \pm C_{ab}Z_aZ_b)}$	9, 17, 19
Electromotive Force Due to Transformation	Field Shape and Distribution of Secondary Winding	$E = 2.22\, f\, Z\, N\, V\, 10^{-8}$	9, 10, 15
	Distribution of Primary and Secondary Winding	$E_2 = B\, E_1 \frac{Z_2}{Z_1}$	16
Air-Gap Magnetizing Current	Distribution of One Winding in Per Cent	$I_0 = \frac{E\, a\, 10^8}{S\, Z^2\, V}$	17
	Distribution of two winding in Series	$I_0 = \frac{E\, a\, 10^8}{SV(C_aZ_a^2 \pm C_bZ_b^2 \pm C_{ab}Z_aZ_b)}$	19
Current Due to Transformation	Distribution of Primary and Secondary Windings	$I_2 = I_1 \frac{Z_1}{Z_2} G$	22
Apparent Leakage Coefficient	Distribution of Secondary and Primary Windings	$q = 1 - \frac{f_{21}\, f_{12}}{f_1\, f_2}$	23
Apparent Leakage Reactance Voltage	Distribution of Primary and Secondary Windings	$E_2'' - E_2' = 2.22 \times 10^{-8} HI_2\, Z_2^2 \frac{V}{R}$	24
Electromotive Force Due to Rotation	Field Shape and Throw of Rotor Coils	$E = 0.0118\, M\, N\, Z\, n\, p\, 10^{-8}$	30, 31

The accompanying tables will simplify the use of the curves. In Table VIII the values of M and f_s are for sine-shaped fields.

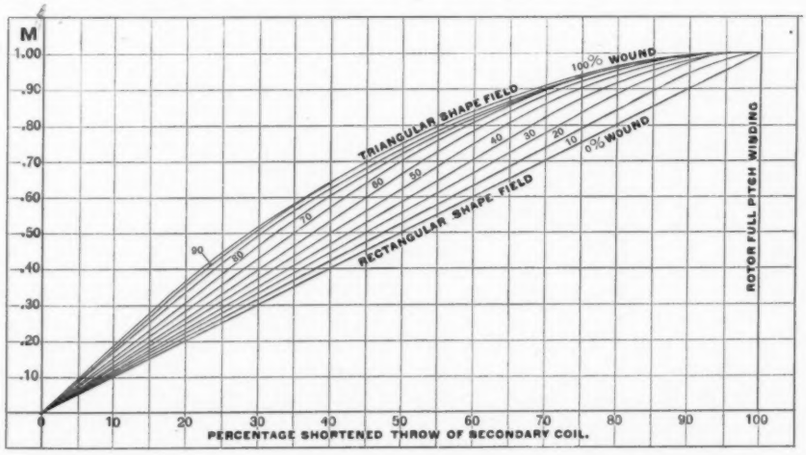


FIG. 31.—CHORD WINDING COEFFICIENT FOR TRAPEZOIDAL-SHAPED FIELD.

Clubhouse for Linemen.

The Portland Light & Power Company of Portland, Ore., has taken a step towards permanently keeping its employees by providing a clubhouse for the use of the linemen employed by the company.

Cleveland Section of the American Institute of Electrical Engineers.

Lamps and illumination were the theme of the programme for the October meeting of the Cleveland Section of the American Institute of Electrical Engineers, which was held on the evening of October 17 in the rooms of the Cleveland Engineering Society.

G. S. Merrill reviewed his paper on "Tungsten-filament Lamps," which he presented before the Toronto Section and which appeared in the September *Transactions* of the American Institute of Electrical Engineers. This paper was a technical study of the tungsten filament and of the reasons for its high efficiency.

M. D. Cooper discussed the stresses which exist in filaments when lamps are burned in a horizontal position and also described the methods of deriving equations for accurately calculating the performance of various types of filaments.

J. G. Henninger gave a brief resumé of the various uses to which Mazda lamps are now adapted, showing that there is almost no field of illumination which has not felt the effect of the high-efficiency lamps.

The importance of providing proper light in industrial work was touched upon by Ward Harrison. The insignificant cost of such lighting when compared with the value of the workman's time, said Mr. Harrison, is quite striking. When artificial light is used but a few hours each day the cost per day of a forty-watt Mazda lamp is perhaps about one-fifth of a cent. If one such lamp is provided for each workman, who we may assume receives an average wage of thirty cents an hour, the saving of twenty-four seconds of the workman's time each day, by reason of the better illumination, would pay the entire cost of operation and maintenance of the lamps. As it is probable that much more time than this would be saved each day, a good rate of return is therefore secured upon the money invested in proper lighting.

The proper method of calculating comparative costs of lighting was also discussed by Mr. Harrison and the necessity of considering the items of depreciation and maintenance and the efficiency of utilization was particularly emphasized. Calculations on this basis show that the cost of producing light with Mazda lamps is less than the cost of equivalent lighting with gas, exactly the reverse of the opinion accepted by many.

J. D. Hoit presented a number of excellent views of industrial illumination, showing the application of the Mazda lamp to various classes of service from steel and textile mills to breakfast-food factories. At the conclusion of this paper a general discussion took place.

For Safer Railways.

Definite standards of safety appliances for railroads were recently decided upon by the Interstate Commerce Commission after a period of about thirty years. It is estimated that the proposed changes in equipment will cost $50,000,000.

CENTRAL-STATION PRACTICE

Transmission—Interior Wiring

ELEMENTS OF POWER-STATION DESIGN.—IX.

PRELIMINARY ELECTRICAL REQUIREMENTS.—II.

BY W. B. GUMP.

Frequency.—For power alone a frequency of twenty-five cycles per second is as high as the best practice permits, and fifteen cycles is being considered in connection with a number of developments. Where the largest part of the load is lighting, a frequency of sixty cycles is common. On the Pacific Coast a frequency of fifty cycles has been adopted in a large number of plants supplying both lighting and power. It is apparent that a compromise must be found between a frequency wholly favoring a lighting load and one adapted entirely to power. The higher the frequency the greater the inductance. This is a great disadvantage in case of long transmission lines, and needs no comment. As the frequency decreases the size of transformers increases, with the same output and voltage, due to extra copper required. Hence the cost becomes a matter of vital importance in low-frequency systems.

Generators.—One of the first items to be settled with respect to generators is the most suitable speed. This will be governed to a great extent by the prime mover. The speed should within limitations be made as high as mechanical conditions will allow. Beyond a certain point the advantages of high speed begin to decrease, due to wear and tear, and, therefore, an increased cost of maintenance.

The regulation to be desired is not generally less than eight per cent. In the majority of cases ten per cent is sufficient and under usual conditions the cost of greater refinement would not be a profitable investment.

The overload capacity of generators will depend upon: (*a*) Type of prime mover; (*b*) load factor; (*c*) number of units.

In the case of turbine waterwheels the maximum efficiency is reached at about seven-eighths of the gate opening. Therefore for maximum economy the generator should run at normal load at the gate opening referred to. The question to be decided in this case is how urgent is the hydraulic economy. In other words, can a certain proportion of water be wasted in waterwheels of greater output, which are capable of accommodating heavier overloads on the generator? Local considerations will accordingly control the rating to be adopted.

Both reciprocating engines and steam turbines may be overloaded from 50 to 100 per cent beyond their rating, and for this reason the overload capacity of the generators for a steam-driven plant is specified accordingly. It is quite common with both hydraulic and steam plants to specify generators capable of carrying an overload of 25 per cent continuously. Beyond this amount the duration of overload to be specified varies according to the nature of the plant.

The allowable temperature rise recommended by the American Institute of Electrical Engineers is 40 degrees centigrade maximum. That is 15 degrees centigrade rise above a standard room temperature of 25 degrees centigrade which is a maximum temperature of 104 degrees Fahrenheit.

Switches and Automatic Devices.—The latest practice with reference to the main generator switches is in favor of nonautomatic operation. With feeder switches equipped with automatic overload relays, the electrical disturbances can generally be taken care of. This provides against interference with the generator itself, and confines the trouble to the feeder directly involved. As far as short circuits are concerned it may be stated that an alternating-current generator of standard design is proof against injury on a dead short circuit for a period of from one-half minute to a minute, and specifications to this effect should be plainly stipulated.

The use of two oil switches in series has frequently been recommended, on the ground that one switch may stick, or otherwise fail to open. At the present time the reliability of oil switches is such that there is no need for two switches on the basis given. For the purpose of testing the operation of each switch separately before closing both on the system, two switches in series offer an advantage. Two-switch combinations are sometimes necessary but are to be avoided when the plan of operation can be so arranged.

The rating of switches should be based upon the maximum current to be carried. An oil switch must stand electrical stresses, and also be able to open under the most severe conditions imposed upon it. These features should not be lost sight of when planning the operation of a system.

The tendency, especially with many large systems, has been to adopt about every known form of automatic device. This has been carried to a point where the system in question was rendered so delicate that its commercial reliability was lessened, dut to interruptions far less serious than justified the opening of a circuit, but which crippled the system for the time being, and thus partially or wholly annihilated the advantages sought. There are without doubt many cases where automatic devices should be installed. Such appliances, however, should not be "stuck" into an electric power system without careful planning and thought. It would more often be better to avoid their use entirely, since continuous service is generally so important that even a burnout in a portion of a system is considered preferable to a shutdown, however short the duration. In every power system there are certain peculiar requirements of a local nature, and these can often be satisfied by some special appliances which are most suitably adapted to the conditions in hand. Consequently a considerable amount of ingenuity is demanded in designing systems in which special apparatus becomes necessary.

When conditions permit the use of

electrically operated generator field switches their adoption in some cases may be advisable as an emergency device. It is generally better when possible to provide an automatic switch in the exciter field than to employ separate field switches for the generators. Reverse-current relays may in a few cases be used to advantage. In few cases, however, have they been reliable, and are not as a rule to be commended. Fig. 7 shows a layout in which reverse current relays are used.

The overload time-element type of relay is one of the most useful of circuit-interrupting devices, and can be used advantageously in connection with outgoing lines, to provide against shutdown in case of trouble disappears shortly after its occurrence. The instantaneous type of relay should generally be used at the load so as to trip before other apparatus may become affected. Automatic busbar switches should in most cases be instantaneous.

Disconnecting switches should be used at points where oil switches or other pieces of apparatus are to be temporarily segregated from energized portions of the system. Disconnecting switches are usually needed on each side of oil switches, although this will depend upon the nature of the wiring scheme used. Observing Fig. 2 it will be seen that only one set of disconnecting switches is used in connection with the main oil switches. This is because of the fact that during repairs or adjustment to one of these switches the generator will necessarily be out of commission. Hence the only point demanding disconnecting switches is between the oil switch and the bus. It is practice in some large power stations to ground the terminals of an oil switch which is being worked upon, thereby preventing any likelihood of live connections.

Switches shown in Fig. 3, which cannot connect to either bus, respectively are commonly termed selector switches. In this arrangement it is necessary to provide disconnecting switches on both sides of the selector switch. Otherwise the selector being repaired would have live contacts on one side, if the generator were operating through the other selector.

The type, and the manner of operating high-tension line switches, are items of great importance, and should be studied most carefully. Where the unit system is employed it is possible to eliminate oil switches on the high-tension side of the transformers. High-tension switches require a large space, are costly and more or less difficult to operate and maintain. The fewer the number of such switches used for a given set of operating requirements the more economical will be the electrical system, other factors contributing favorably. The elimination of high-tension switches necessarily affects a material saving in building space, and also simplifies the operation of the plant, which is another advantage generally to be found in the unit system.

In general, hydroelectric plants are less restricted as to building space than steam plants as far as the question of real estate is concerned, so that the former need not be cramped for space sufficient to accommodate all of the apparatus in a manner which renders it accessible. With either type of plant the cost of more or less elaborate switching apparatus must be balanced against the commercial advantages to be gained by increased flexibility.

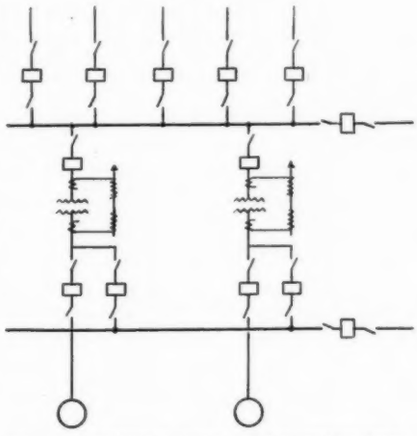


FIG. 7.—SHOWING USE OF REVERSE-CURRENT RELAYS.

Grounded Versus Ungrounded Neutral.—The question of leaving the neutral ungrounded, or grounding it, is one which confronts every electrical engineer who has to do with alternating-current transmission and distribution. This question has been the subject of a great deal of discussion, and much more is likely to follow. In a perfectly balanced three-phase system (either delta or star) the neutral point remains at zero potential (that of ground) and therefore is constant and stable. Unbalancing, however, tends to shift the neutral point to new position, determined by the rise or fall of potential in one or more legs of the system. The primary object then in grounding the neutral is to maintain a condition of stability, preventing excessive pressure taking place between any of the lines and ground, and thereby greatly reducing the danger of oscillations and high-power surges. Such phenomena may occur from lightning or on account of switching. The former cause is the one generally to be most dreaded by those in charge of electrical apparatus.

One distinct advantage in grounding the neutral of a high-tension system is the removal of static, and the prevention of disturbances in neighboring lines due to induction. Another advantage is that the ground may be used as a working conductor. This has been done in a good many systems employing potential above 20,000 volts. For lower potential it is not generally practicable, on account of the high resistance of the ground. This overthrows the old-time belief that the resistance of an earth path is negligible. In practice it has been found to be far from the case, especially where dry soils or rock strata exist.

With the neutral grounded it becomes possible to operate a three-phase transmission system when one line is out, provided, of course, that both the generating station and substation are grounded. Otherwise only one phase would remain operative.

In deciding that the neutral should be grounded the next thing to be settled is whether a resistance shall be interposed or maintain a dead ground. It may be stated that the experience of engineers in connection with systems operating on a grounded neutral is that a resistance is generally to be preferred. With a dead ground the violence of a short circuit is apt to be communicated to other portions of the system before the circuit-breaker can act to remove the trouble from the injured section.

There are some disadvantages in grounding, one of which is the likelihood of a short circuit, due to grounds on any outside portion of the system, whereas with the neutral ungrounded two conductors must break down before a short circuit can take place. A good ground is difficult to obtain and is found to be a rather variable quantity. The amount of resistance interposed between the generator ground plate and a breakdown at some remote point may be so great as to affect only a partial ground, and be productive of considerable trouble before it becomes evident.

(To be continued.)

CENTRAL-STATION ECONOMY—IV.

CENTRAL HEATING.

BY P. E. MATTESON.

There are very few central heating plants in this country, for several reasons. The chief reason is because such heating will not pay except as a secondary product of a steam plant, other reasons are because central heating plants must be located not too far from the buildings to be heated, and all the buildings to be heated must be concentrated in a small area. These conditions are generally present in the central station.

There are many reasons why any central station with the above qualifications should engage in central heating; exhaust steam could generally be depended upon for sufficient heat except on very cold days, and with the exception of these very cold days when live steam would be required, little expense could be charged to the heating plant. Central heating would also help materially in securing certain classes of business for the electrical department which could not otherwise be handled, for example hotels, which require large quantities of radiation and hot water, and unless they can secure this service from central plants are very apt to generate their own current and run their own elevators, merely because they must have the heat, and the current is a by-product.

Hot water is the most satisfactory method of distributing heat from a central plant, because hot water would utilize the heat in the exhaust and would not require a special boiler. Hot-water systems hold their heat best, take up heat quickest, are operated at a lower temperature than steam, and in all respects are more satisfactory than steam heat.

For the purpose of arriving at a clear conception of the possibilities in central heating, the specific case of a 200-horsepower steam plant will be considered, assuming the steam consumption to be eighteen pounds per horsepower-hour. We will also assume that this plant is located close to the buildings heated, the lines being not more than four blocks in length. The heat customers are stores and office buildings.

A 200-horsepower engine using eighteen pounds of steam per horsepower-hour would exhaust an atmospheric pressure 3,600 pounds of steam per hour. One pound of steam at atmospheric pressure contains 967 British thermal units of latent heat, the hourly heating value of the total engine exhaust is therefore $967 \times 3{,}600 = 3{,}481{,}200$ British thermal units.

This heat transferred to water would impart heat as follows: The available water supply delivers water at 60 degrees which is heated to a temperature of 200 degrees at an expenditure of 140 heet units; 3,481,200 heat units would thus raise the temperature of about 24,000 pounds of water to 200 degrees every hour, allowing for some loss in the heater.

If care is taken in the construction of the feed mains, water could be delivered to all the customers at a temperature no less than 170 degres. Taking this as a basis for calculation the amount of radiation available can be easily computed. According to a heating rule for ascertaining the radiation available with hot water at 170 degrees, multiply the units of heat in the hourly water supply by the constant 0.0056 and the result will be the square feet of radiating surface obtainable, in this case 14,000 square feet.

Allowing twenty-five per cent of this available radiation for offices and the other seventy-five per cent for stores, 14,000 square feet of surface would heat no less than seventy offices and twenty stores of average size to a temperature of sixty-five degrees in the coldest weather.

Heat from a central plant should be sold on a meter basis because it would be impossible to estimate the costs and profits of this department unless an accurate record be kept of the heat used by each consumer.

The average rate for heat of fifty central heating plants on record is five cents per month per square foot of radiating surface, on a flat rate. Accepting this as a fair rate, the heating plant here described, to arrive at the same results with customers on meters instead of the flat rate, should charge approximately six cents per thousand pounds of hot water delivered. There should be a recording instrument on the line aside from the flow meters for the purpose of ascertaining at all times the temperature of the water delivered, and the statements for heating should be issued in proportion to the amount of heat delivered. By adopting this policy any periods of extreme cold, during which live steam would have to be used, would not have to be carried at a loss to be made up in milder weather, but would return as much profit as would be available in warmer periods.

The receipts of the heating plant operating as above would be between $5,000 and $6,000 per season, and the cost of operation would be very low for except on a few occasions the steam used by the heating plant would be charged to the electrical department. The cost of the installation would be low as the heat pipes could be run in the basements of buildings saving the cost of digging trenches and manholes.

Unfortunately the central heating is required only about six months of the year leaving the exhaust steam unused the balance of the time. The installation of an ice plant to utilize the exhaust steam in these periods would result in an extremely profitable central station.

Of course central heating would not prove so profitable to all central stations. Exhaust steam could be used in many steam plants more advantageously than for central heating, but for the steam plant whose location is right and the exhaust is used for no purpose at all or only for feed-water heating, this use for exhaust would be most profitable.

The Colorado River Dam.

A dispatch from Austin, Tex., states that the contract for the reconstruction of the dam across the Colorado River at Austin at a cost of $1,000,000, which was let several months ago by the City to the Dumont-Holmes Steel Concrete Company of Chicago, is about to be transferred to the Hydraulic Properties Company of New York. The original contractors have done merely enough work to keep alive their contract. The proposed dam will form a water-storage reservoir that will provide power for about 6,000 horsepower of electrical energy.

After some litigation, which has now been settled, the Great Western Power Company has practically completed its rights of way for its second high-tension line between Oroville and Oakland, Cal.

ELECTRIC LIGHTING and ILLUMINATING ENGINEERING

ILLUMINATING ENGINEERING SOCIETY.

FOURTH ANNUAL CONVENTION AT BALTIMORE.

The fourth annual convention of the Illuminating Engineering Society was held in Baltimore, Md., October 24 and 25, the sessions being held at Johns Hopkins University. Every condition was most favorable for a successful convention and the registration on the first day amounted to 175. This meeting will go down in history as epochal in the life of the Society. It was distinctive in that it is being followed by a course of lectures in illuminating engineering given under the joint auspices of the Society and Johns Hopkins University. The attendance at this course is larger than was anticipated and its success is a tribute to the energy and enterprise of the officers of the Society.

The first meeting of the convention was called to order in McCoy Hall on Monday morning by the chairman of the Convention Committee, Van Rensselaer Lansingh, who turned the chair over to the president of the Society, Dr. Edward P. Hyde. Dr. Hyde introduced the Hon. J. Barry Mahool, mayor of Baltimore, who delivered a graceful address of welcome. After acknowledging this on behalf of the Society, Dr. Hyde called upon Dr. Ira Remsen, president of Johns Hopkins University, who welcomed the Society on behalf of the University with true Southern hospitality.

This was followed by the annual address of the president. Dr. Hyde chose as his subject "The Goal of Illuminating Engineering."

PRESIDENT'S ADDRESS.

After pointing out the rapid progress of illuminating engineering both as a science and an art, he dwelt upon its complexity, involving, as it does, physics, physiology and psychology. It combines the laws of science with the dicta of architecture; its goal is the ideal application of perfect knowledge. An ideal illuminant would transform all the expended energy into light of the quality of sunlight. We are far from its attainment. If complete transformation could be obtained in the yellow or green part of the spectrum, an efficiency of 800 lumens per watt would result. If the distribution in the spectrum corresponded to daylight, 300 lumens per watt would be obtained. Such a distribution is not obtained from a black body nor from any source of electric emission. It is to be sought only in luminescence. Even if attained it would not correspond to radiation from the sun, since the latter contains the ultra-violet, which may be very necessary. In its full significance efficiency means the ratio of satisfaction to cost. The development of illuminating engineering is not abreast of the auxiliary sciences upon which it depends, our knowledge being very meager. Consistent development requires progress along all the correlated sciences. Economy and distribution are not the only features to be considered; to be effective, illumination must be attractive and artistic, restful to the eye, proper in both quantity and quality, and must give the proper high lights. The object of the speaker was to suggest rather than to specify how or what should be done, and to exalt the ideals involved.

Past-president Sharp occupied the chair during this address and at its conclusion appointed Messrs. Elliott, Rosa and Dates a committee to consider it.

The report of the Sub-committee on Photometric Units of the Committee on Nomenclature and Standards was then presented by Dr. C. H. Sharp.

This was a progress report in which definitions of illumination, intensity, brightness, quantity, etc., were given and recommendations were made for the use of the lumen as the unit of flux, the lumen per square foot or millilumen per square centimeter as the unit of illumination in preference to the candle-foot, and the lux as a meter-candle. All units are to be based upon the international candle, and specific intensity to be expressed in candles per square centimeter normal to the surface. Spherical intensity is the total flux divided by 4π and quantity of light is to be measured in lumen-hours or lumen-seconds. Recommendations of symbols were also made, but as these included E and I some objection was made on account of confusion with the electrical symbols.

In the discussion which followed, E. B. Rosa suggested co-operation with foreign countries before taking definite action, since international uniformity is desirable. Some of the symbols and units proposed are already used abroad but some are not.

A. J. Pearson suggested that other societies, such as the American Institute of Electrical Engineers, should be consulted before taking action, and there were various other suggestions made.

In closing the discussion, Dr. Sharp called attention to the fact that Dr. Blondel, of France, was on the Committee and it was hoped to secure the adhesion of France, and also of England, whose Illuminating Engineering Society was likely to take up the subject in the near future. The lumen and candle are independent of the unit of length and the derived units may be expressed in terms of either English or French measure. The Germans use "lux" as based on the hefner, but it is preferable to call such derived units "hefner-lux," "hefner-lumen," etc.

The Committee was instructed to render a final report at the next annual convention, and meanwhile to seek the co-operation of foreign countries.

The report of the Committee on Division of Membership was next presented by its chairman, E. L. Elliott. The report advocated such a division, the time and manner of carrying it out to be decided by the Society. This precipitated a long discussion whose principal effect seemed to be to obscure the objects and advantages of such a division, and finally the report was accepted without action.

The afternoon session was held in the Physical Laboratory and was opened with a paper by C. F. Oehlmann, entitled "Central-station-illuminating-engineering Department Work and Methods Applied by the Denver Gas & Electric Company." In the absence of the author this was read by Mr. Williamson.

CENTRAL-STATION ILLUMINATING ENGINEERING WORK.

This paper described the work which is carried on by the Illuminating Engineering Department of the Denver Gas & Electric Company, the primary purpose of which is, of course, to get and hold customers by answering complaints and proposing new plans for illuminating. The illuminating engineer has an assistant, who does the architectural drafting, fixture designing, writing of wiring specifications, and keeping of records which may be necessary. Samples of both gas and electric lamps, burners,

shades, reflectors, etc., are kept in the office to show visitors, and the care of the different form of lamp is explained. The defects in fixture designing are dwelt upon. The three decided purposes which characterize the three distinct branches of illumination are (1) interior illumination for ordinary lighting, and street lighting; (2) scenic illumination for theaters, art galleries, etc.; (3) sign lighting and other advertising. The three essential points in illumination are right quantity, right quality, and right use. There is another set of three factors, namely: the manufacturer, the customer and the commercial department, which connects the other two. The customer and the station must be in harmony, and while the central stations have realized this fact and do a great deal of educational work among the public, consumers still know very little about illumination. The best method of getting good results is to maintain an illuminating engineering department. Seventy per cent of this department's work is in straightening out complaints which have arisen because the consumer has not been properly taken care of in the first place. The classes of business to be sought for are street-lighting contracts, all-night service for advertising purposes, safety lights which are burned by night in stores, and small lamps for show-window heating to prevent frost in winter time. The services of the department are free to all customers and help is given them in the improvement of design of a lighting installation. The basis of complaint is carefully investigated and, when possible, is remedied. Careful records are kept of all such cases. The complaint of the customer is usually not so much the cost of the service as it is quality. When by rearranging the system he gets three times as good illumination as before he is usually willing to pay the bill. An illuminating engineering class is organized each fall, in which the representatives of the company are given an opportunity to keep in touch with the subject.

Sidney W. Ashe opened the discussion of this paper by calling attention to the courses in illuminating engineering carried on by the General Incandescent Lamp Company for the benefit of its employees. College graduates in the employ of the Company constitute one of the classes and receive lectures on illuminating engineering subjects for a period of one year. These are supplemented by factory and laboratory work. They are then transferred to the sales department, engineering department or laboratory, according to their qualifications. Men intended for lamp salesmen constitute another class who receive instruction in technical subjects. Salesmen already in the field constitute a third group; they are trained to give lectures, etc. Office and factory employees resceive an experimental lecture course in electricity and illumination.

A. J. Marshall spoke of the desirability of enrolling architects in the Society and pointed out that they should be given due consideration in the discussions at the meetings.

Norman Macbeth called attention to the situation in Denver where one company controlled both the gas and electric business. He said that such a condition, where competition between these two industries was eliminated, makes it possible for salesmen to sell lighting appliances to customers without respect to engineering consideration. He further emphasized the necessity for educating central-station solicitors, pointing out that after a contract has been closed, if the inefficient solicitor has advocated the use of unsuitable units to the customer, the illuminating engineering department is helpless.

Mr. Williamson closed the discussion. In answer to a question as to the specification prepared by the Denver Company he said that complete specifications are gotten out for both gas and electric installations.

The cost of soliciting had been decreased, for a good installation was the best salesman. The assistant received $3.00 per day, and turned out about one job per day.

This discussion was followed by a very interesting address by Prof. Samuel O. Mast on the subject of "The Effect of Light on the Movement of Lower Organisms."

EFFECT OF LIGHT ON LOWER ORGANISMS.

While strong direct sunlight is injurious to most lower organisms, causing a chemical breakdown of the protoplasm, and while ultra-violet light kills bacteria, light is nevertheless necessary to all life, and in the chlorophyl of plants light has a synthetic action in causing carbon dioxide and water to form organic compounds. Experiments were described which had been carried out upon a minute organism found in the Baltimore sewer water. This possesses the power of locomotion and will move into a lighted space from the dark and towards the source unless the illumination is already too strong, in which case it moves away. The method of locomotion was described by the author. The greatest effect is produced by blue and violet light, while the ultra-violet is ineffective. Considerable individual variation is shown as to the optimum illumination, and this may even be altered in a particular individual.

In the discussion, P. W. Cobb pointed out the similarity of response to stimulation in such organisms of a single cell, and in the cells of more complex organisms, such as man. Thus in the retina, the position of the cones is altered where light impinges upon them.

The next paper was by J. S. Codman and was entitled "Illuminating-Engineering Sheets for the Calculation and Recording of Data."

SHEETS FOR RECORDING DATA.

Mr. Codman's paper describes two data sheets designed by him to facilitate the calculation and recording of illumination data for any type of lamp. Many illumination problems are not scientificially solved because the calculations are laborious. These data sheets have the constants for different angles tabulated so that these are readily used in the calculations. On the "angle" sheet the diffrent columns are as follows: Angle, tangent, candlepower, cosine squared, normal illumination, cosine cubed, horizontal illumination, lumen constant, lumens, area of ring, average illumination, uniformity, lumen sums, lumen sums lamp unequipped, per cent equipped to total flux, area of circle, average illumination, uniformity. The angles are given in five-degree steps from zero and 180 degrees. After the corresponding candlepowers are tabulated the remaining ten columns are easily filled by progressive computation with the aid of the tabulated constants. The "distance" sheet is like the one just described except that the first two columns are interchanged and the distances from the perpendicular are given up to six times the height of the lamp.

V. R. Lansingh called attention to a short method of getting the values of illumination from the distribution curve.

The final paper of the session was entitled "Some Neglected Considerations Pertaining to Street Illumination," by Preston S. Millar.

STREET ILLUMINATION.

Objects in streets at night are discerned most usually as silhouettes against a lighted background. The first requirement of good street lighting is for a well lighted street surface to serve as a background. It is the effective brightness of street surface, or the brightness as seen when viewing the street longitudinally at an angle of two or three degrees, which determines the value of the surface as a lighted background. The effective brightness may be increased by providing a greater number of more powerful lamps or by repaving the street with material having more favorable light-reflecting qualities. The light distribution characteristics of all commercial illuminants being unsuitable for street lighting, it would appear feasible to increase the effective brightness of streets by directing a larger proportion of the light upon the street surface. With a given intensity of incident light the effective brightness of a street is greatest when the lamps are mounted over the driveway. Non-uniformity of illumination, while undesirable is not so objectionable as has been asserted, because the effective brightness of a street surface does not vary as much as does the intensity of incident light, and the bright street surfaces near lamps assist in discernment of large objects in the dimly lighted regions. Glare must not be neglected. Its effect becomes harmful when the glaring source is very near (less than five degrees removed from) the object to be seen or when there is no lighted background against which to view objects. In ordinary city installations the glare from street lamps may dazzle temporarily after one looks directly at the lamps, and may increase the chance of failure to perceive a barely perceptible object in a hasty, careless glance. But otherwise it occasions no material decrease in ability to see objects. It is entirely feasible to design a lighting installation in which there shall be entire absence of objectionable glare while securing high effective brightness of street surface. But usually in practice one must choose between decreased effective brightness of street on the one hand and some degree of glare on the other. For each such installation there is some compromise which will produce the best results. The proper compromise can be reached best, not as a matter of theory or prejudgment, but as a matter of trial in the street, preferably

including a determination of ability to see under the various conditions. The problem of street illumination is not simple when considered alone as a matter of theory. The additional elements which commercial conditions introduce render it extremely complicated in practice. A number of the factors which enter into the problem might be studied independently with profit. But the application of the results of such studies must always be made with due regard to the importance of other factors. Our tenets of street illumination must be broad-gauged and must give proper weight to all elements of the subject, whether scientific or commercial.

In the discussion which followed Messrs. Sweet and Ware expressed the opinion that glare and specular reflection should be avoided as much as possible. Silhouetting appears only with long spacing between units, which is undesirable and is disappearing, as it is easy now to get nearly uniform illumination. Under modern conditions one sees mainly by surface contrast. Mr. Sweet had made experiments upon glare and found results somewhat similar to the author except that the effect became *nil* for an angle of twenty-three degrees instead of fifteen. He also found a straight-line variation.

C. H. Sharp replied and gave his evidence that silhouetting was prominent even in well lighted streets, and only disappeared when the street surface was black. There is no problem in street lighting when plenty of lamps are available; the problems arise only when one is restricted, as is usually the case. Glare is not important when there is plenty of light. Glare acts in two ways: it produces a zone or halo in which vision is impaired, and it also tends to distract attention. The presence of such a zone indicates that the curve connecting this effect with angular position would not be a straight line.

S. W. Ashe referred to some experiments made long ago at the single angle of eight degrees which confirmed the results of the author.

G. H. Stickney agreed with Dr. Sharp as to glare. Switchmen prefer a light directed toward them, giving a silhouette effect with glare, rather than to have the light directed in the reverse direction. With a reflector giving a distribution varying with the azimuth there is difficulty from wrong mounting, and such a reflector had been designed by him and abandoned.

H. E. Ives pointed out that street lamps are usually high enough to produce no glare within the small angle where it is effective, but that show-window lights which are not concealed are frequently on the eye level and very objectionable.

On Monday evening Van Rensselaer Lansingh delivered a public lecture on the subject of "Illuminating Engineering." Owing to the limited time at the disposal of the speaker and the character of a large share of the audience, only the generalities of the subject were touched. The address, however, was supplemented with impressive demonstrations.

A portion of the evening was also devoted to viewing the apparatus to be used during the course of lectures which immediately follows the convention.

At 9:30 p. m. a reception was given to the members of the Illuminating Engineering Society and their guests at the Hotel Belvedere. Following the reception an informal dance was held and a very enjoyable time spent.

The ladies were taken for an automobile ride in the afternoon.

A report of the sessions of Tuesday will be given in the next issue.

Effect of Incident Angle on Coefficient of Diffused Reflection.

At the meeting of the Philadelphia Section of the Illuminating Engineering Society that was held on October 21, Francis H. Gilpin, of Philadelphia, presented a paper on the "Effect of the Variation of the Incident Angle on the Coefficient of Diffused Reflection."

An experimental study was made of the relation between the incident light and the reflected light for different angles and various finishes and colors of wall paper. The ratio of the reflected lumens and the incident lumens expressed as per cent was found for angles of sixty, forty-five, thirty, fifteen and zero degrees with the normal for each of the twenty samples tested. For a matt surface the greatest efficiency is at an angle of forty-five degrees, which for other types of surfaces the angle of maximum efficiency varies, increasing with the angle as a rule. Assuming that the same colors were used, the results of the investigation indicate that for high, narrow rooms, for indirect lighting, or where the lamps are placed near the walls, a glossy paper gives the best results; while for flat rooms, or centrally located lamps, the difference between the rough and smooth papers is practically negligible.

Special Street Lighting in Minneapolis.

The city of Minneapolis was one of the pioneers in the present popular movement for decorative street lighting that is sweeping over the country. About six miles of its business streets are illuminated by means of attractive tungsten clusters that have been declared by many visitors to be of the most pleasing design to be found in this country. The chief credit for this work is due to the Publicity Club of Minneapolis, a report of whose street-lighting committee has just been made. As submitted by Chairman C. B. McCall, the report gives for the first time a good idea of the immensity of the labors of the organization extending over a year in producing one of the best attractions Minneapolis possesses.

Mr. McCall's report, prepared preliminary to the visit which a committee of the civic organizations made to the Board of Tax Levy shows that 504 ornamental lamp-posts have been erected and lighted. Of these twenty were put up by the City, twenty-three by private persons, and 461 by the Publicity Club.

The total cost of this work, including electric current and maintenance for the year, original promotion of the lamp plan, and incidental expenses, has been $109,000, all subscribed by property owners and tenants. The cost of maintenance and current has been at the rate of $78 a year a post. The lighting company insures the lamp standards and paints them, replaces lamps and poles, supplies the current and the "on and off" service each night.

Each of the standards is surmounted by five 100-watt tungsten lamps. There are 2,520 lamps in all, covering fifty-nine city blocks. One year ago property of the value of $12,000 in posts and equipment was given to the city for nothing. This year similar property valued at $43,000 will be deeded to the municipality. The deeds include 150 street signs, placed at the four corners of street intersections on each of the illuminated streets, which cost about $750.

A committee from several civic organizations, including the Publicity Club, has called on the Board of Tax Levy to urge that the city be empowered to assume the cost of lighting and maintaining the new lamps, inasmuch as the merchants and property owners have borne the entire burden for over a year.

TELEPHONY—TELEGRAPHY, and WIRELESS.

TELEPHONE TRAIN DISPATCHING.—VI.

AUXILIARY APPARATUS.

BY K. W. ENDRES.

In addition to the regular telephone and selector equipment in daily use upon train-dispatching circuits, the conditions to be met are such that various types of auxiliary equipment are also required in many cases. A railroad generally starts in with but one

FIG. 1.—PORTABLE TELEPHONE SET FOR WRECKERS.

circuit for this service, so initially its requirements as to flexibility are small. Soon, however, more lines are added and then the road wants various additional pieces of apparatus in order to obtain the maximum efficiency out of its equipment.

It is also highly desirable to be able to make simple tests and patches on the telephone circuit, such as are accomplished on the peg switchboard in telegraph service. If more than one metallic circuit is available, it is always wise to make provision for interchanging the different ones with each other in case of emergency.

Quite frequently also trains are blocked by telephone and this, too, requires consideration in designing a train-dispatching system. Especially so since block wires are in practically all cases short grounded lines, working from one station to the next or the second beyond on either side. These conditions peculiar to railroading have obviously necessitated new and substantial equipment to meet them.

Perhaps the simplest and yet the most troublesome of all the auxiliary apparatus are the protective devices. It is fairly safe to say that no perfectly satisfactory protector has yet been developed by anyone. The trouble has not been from lack of thought or engineering ability put into them, but because two irreconcilable conditions are met in telephone protection and so far have rendered the problem unsolvable. The protector must guard the apparatus from low-voltage crosses, such as lighting and power wires, as well as from lightning. It must, therefore, operate at a low potential. When built with this in view, the ground plate is in all cases so near the live plates that the spark gap between is easily crossed by foreign matter, carbon dust, metal or whatever material the plates are made of.

This, of course, grounds the line permanently and renders it inoperative from noise, if there are any foreign telegraph or power circuits in the neighborhood. If the plates are placed at a greater distance apart, the operating voltage is much higher and the apparatus is not, therefore, protected as it should be.

It has not been possible to solve this contradiction as yet, but since the railroads' main object is to give service and they cannot stand for continued interruptions to it from grounds in the protectors, it seems probable that they will dispense with so much protection and take a chance on having apparatus burned out occasionally rather than interrupting service so frequently from grounds.

Protectors which place permanent high-resistance grounds on the line are, of course, useless for telephone purposes on account of the noise which they bring into the circuit, aside from other disadvantages, such as slowness in dissipating a charge.

The portable telephone as used on wreckers and regular trains is shown in Figs. 1 and 2. The first of these is a large-size magneto set equipped with a five-bar ringing generator and of the most efficient construction throughout.

Provided the dispatcher has an extension bell, he can be rung up in case of absence from his desk by this set. Furthermore, the set can be connected to a message or block wire and can

FIG. 2.—PORTABLE TELEPHONE SET FOR TRAINS.

signal the nearest operator. On these types of circuits the operators are not connected in at all times and hence must be signaled. For this reason this is the type of set usually employed for wreckers or construction trains.

For use on regular trains to enable the conductor to reach the dispatcher in cases of emergency a special portable set has been designed as shown in Fig. 2. It is for use on telephone train-dispatching lines where the dispatcher is connected to the circuit at all times and therefore contains no generator and only a small buzzer so that the dispatcher can be called with this set when it is connected to the line.

Both these sets are connected to the telephone line at any point desired by means of a jointed fishing pole with a specially designed head section. This head spreads out and firmly clasps the

two wires, thus giving a good connection. A pair of wires run from it for over 100 feet and are connected to terminals on the portable set.

When there is only one circuit installed along a railroad and no provision has been made for altering existing telegraph circuits so that they can be used for patching it in an emergency, such a circuit is usually merely looped through three knife switches at each way station. Fig. 3 illustrates this.

With this simple arrangement it is possible for the dispatcher to locate trouble between any two stations by

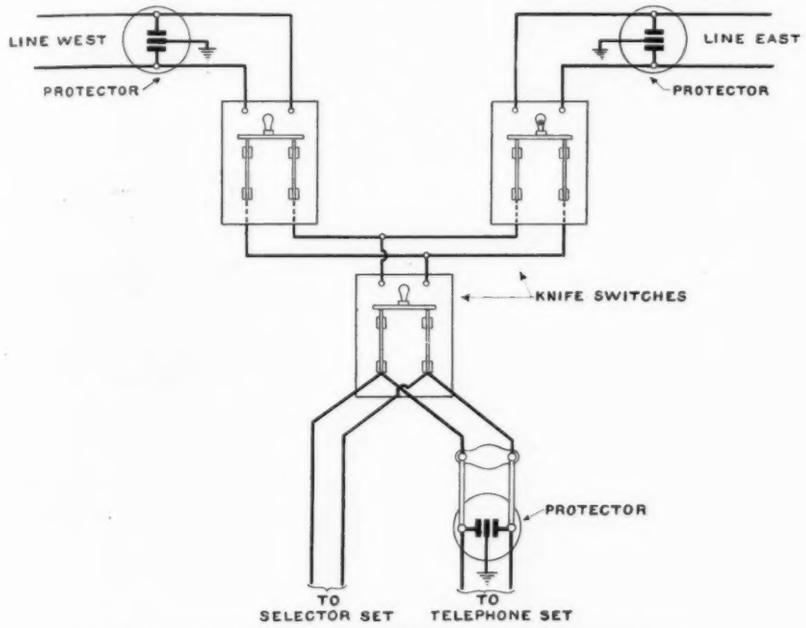


FIG. 3.—WIRING OF SINGLE CIRCUIT THROUGH WAY STATION.

successive tests down the line, opening the circuit in one direction and then in the other and finding thus where the trouble is cleared. In case of trouble in the station apparatus, that station can be cut off the line by the third switch, leaving the circuit cut straight through.

Frequently, however, the railroad has more than one telephone circuit installed along a division. The usual number is three; one train-wire circuit, one message circuit and a block wire. The two former are metallic-circuit copper lines, the latter usually a No. 8 iron grounded circuit between stations. In such a case knife switches become too cumbersome for testing and patching and a telephone test board is used instead. This is shown in Fig. 4.

The illustration shows a test board half equipped or ready to receive two metallic circuits. Two rows of jacks are employed with designation strips beside them. A grounding jack will also be observed in the center at the bottom. Below this is space for two keys, one of which is installed in this case. The patching cords hang from the bottom.

The wiring diagram (Fig. 5) illustrates the simplicity of the test board. The wires each come into an individual jack on one side, then through its inside contact and out similarly through the corresponding jack on the other side. The selector and telephone set are wired also from these inside contacts across a pair of jacks. The line thus normally is cut straight through and the station apparatus bridged across it.

The selector and telephone-set wiring passes through a key whose outside contacts are connected to four pairs of patching cords. Therefore operating this key throws the selector and telephone set across the cords and off the jacks. Each pair of cords is of a different color: red, white, green, and black.

Suppose there is a break in the train wire between two stations. It is desired to patch this with the message circuit paralleling it. Assume that the train wire is on jacks Nos. 1, 2, 3, 4 and the message circuit on jacks Nos. 9, 10, 11, 12. The operator at the last station before the break is instructed to insert the black cords in jacks Nos. 1 and 10 and the green cords in jacks Nos. 3 and 12 and to throw the left-hand key. Similarly at the next station beyond the break jacks Nos. 9 and 11 are patched to jacks Nos. 2 and 4, respectively, the key is thrown and the trouble temporarily cleared on the important train wire.

Inserting a plug into a jack opens the wire at that point. Inserting two plugs on cords of the same color into any two jacks connects those two wires together. Placing a plug in the ground jack and the plug on the other cord of the same color into another jack grounds that wire. In this way all the ordinary simple tests usually made on a line of this character can be most easily carried out.

It is quite often the custom to loop

FIG. 4.—RAILROAD TELEPHONE TEST BOARD.

a couple of telegraph wires through this board on their way to the peg switchboard. They, too, can be used for patching the telephone circuit in case of need. This is further carried out by so modifying the line construction of the Morse wires that they will not harm the telephone circuit when patched into it—namely, by means of transpositions and soldered joints.

Where block wires are also installed they are always carried through the test board for testing and patching purposes. Sometimes they are wired from here to separate telephone instruments, at others they are carried to a blocking set and together with the train and message circuits use a common telephone set.

The blocking set which enables this to be accomplished is shown in Fig. 6.

The set is a compact piece of apparatus and is mounted conveniently for the way-station operator to handle. It contains on top a repeating coil with a key for throwing this into circuit just below. This repeating coil is for use when it becomes necessary to connect a metallic circuit to a grounded line and eliminates the noise which would otherwise be introduced.

Next in order below are three combination jacks and signals with a designation strip above them. The block wire in one direction is brought into one of these; the block wire in the other direction to another. The middle signal can be used for a private line in the neighborhood of the station, such as a line to a water tank, round house, siding, etc. These lines may be either metallic circuit or grounded; being short they are usually the latter.

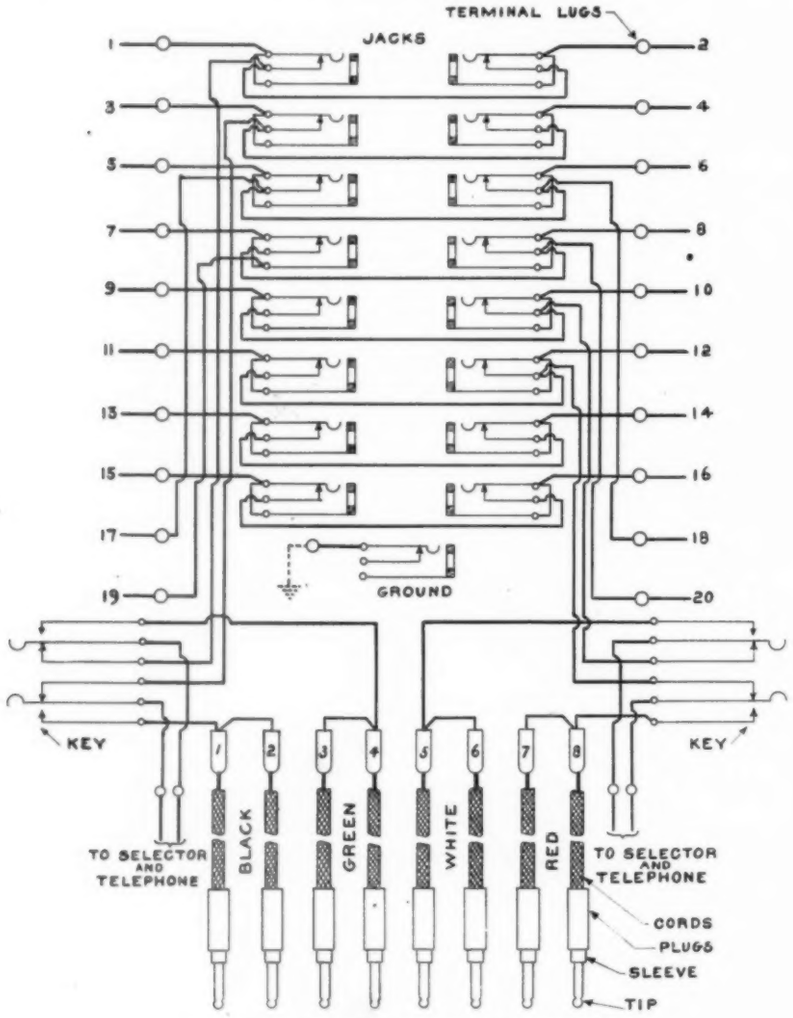


FIG. 5.—WIRING DIAGRAM OF TEST BOARD.

The four jacks across the bottom of the set are wired to the train wire, message wire and one each across the two pair of patching cords on the sides of the set. The cord and plug to which the operator's telephone set is connected hangs from the bottom of the set.

When the next block rings up a red target is displayed above the jack and this rings a bell in a local circuit. The operator answers by plugging his telephone cord into the jack below the target. This automatically restores the target and stops the bell. When the selector bell on the train or message wire rings he answers by plugging this same cord into the proper jack at the bottom of the set. Thus he uses the same telephone set on all calls.

There are two pair of patching cords on the blocking set as mentioned. The repeating coil and key is wired in connection with one set of these and they are used when it is desirable to connect, say, the train wire (metallic circuit) to a block wire or private line (grounded). One plug of the pair is inserted in the train-wire jack at the bottom, the other in the proper block jack and the repeating-coil key is thrown. The way-station operator can still listen on this connection by plugging his telephone cord into the jack that bridges the pair of cords in use.

If the way-station operator goes home for meals or for the night and leaves his station shut up, he first takes the other pair of patching cords (the block-wire cords) and plugs one into each of the two block-wire jacks. These two adjacent blocks are then connected straight through this office and blocking service is continued uninterruptedly, but with one station omitted.

FIG. 6.—RAILROAD BLOCKING SET.

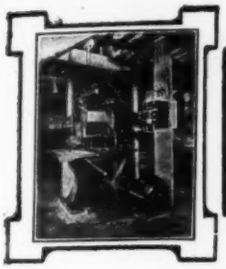
The flexibility of a railroad telephone system for handling train movements, commercial messages and blocking work is obvious from the above. When to this feature are added the many other advantages of the personal method of communication it is small wonder that the telephone is advancing into this new field with rapid strides.

Wireless in the German Army.

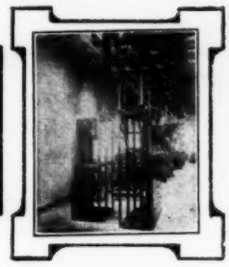
A new automobile car, manned by six operators and equipped with a wireless outfit having a telescopic mast, is about to be supplied to certain regiments of the German Army. The radius of the wireless outfit is 100 miles, both for transmitting and receiving.

Cable Concession.

The International Telephone Company of Brazil has obtained a concession for laying telephone cables between Rio de Janeiro and Nictheroy.



Industrial Power



BREAKDOWNS OF ELECTRICAL MACHINERY.

REPORT OF MICHAEL LONGRIDGE, CHIEF ENGINEER OF THE BRITISH ENGINE, BOILER AND ELECTRICAL INSURANCE COMPANY.

Michael Longridge, chief engineer of the British Engine, Boiler and Electrical Insurance Company, Limited, of Manchester, England, has recently issued his report for the past year. The following section of the report is subscribed under the caption "Inspection and Insurance of Electrical Machinery."

The percentages of increase and decrease, as compared with 1908, were:

	Dynamos.	Motors.	Starters or Controllers.	Totals
Machines insured increase, per cent	3.6	8.3	13.4	9.8
Breakdowns, decrease, per cent.	22.0	6.2	7.5	4.1
Cost decrease, per cent	43.8	1.8	18.8	9.5

The rates of breakdown among the various classes of machines were these:

Dynamos—Continuous current, 1 in 17.2; alternating current, 1 in 17.5.

Motors—Continuous current, 1 in 8.2; alternating current, 1 in 9.5.

Dynamos and Motors—Continuous current, 1 in 9; alternating current, 1 in 9.7.

Starters and Controllers—1 in 25.

The proportion in which the various parts of the dynamos, motors, starting switches, and controllers insured in 1909 caused or initiated the breakdowns of the year are given in Table I, with the corresponding figures for 1908 and the averages for the preceding seven years.

As a large majority (eighty-five cent) of the machines insured are motors, it may be interesting to tabulate the figures for the last two years for continuous and alternating-current motors, separately, as in Table II.

The causes of the year's breakdowns were probably as given in Table III.

A few of these breakdowns are described in the following paragraphs:

1. Four-pole series-wound 16.5-horsepower motor, two years old, receiving current at 440 volts from the outer wires of a three-wire continuous-current system, with the

TABLE I.

Description of part which is believed to have failed first.	DYNAMOS. Average for seven years previous to 1908.	1908.	1909.	MOTORS. Average for seven years previous to 1908.	1908.	1909.
Rotating parts carrying current—						
Armatures and rotors, per cent	57.3	30	40	51.4	36	37
Commutators and slip rings, per cent	20.0	40	29	22.0	26	27
Stationary parts carrying current—						
Magnet coils and stators, per cent	8.6	11	12	13.6	16	20
Brush gear and terminals, per cent		0	3		5	4
Rotating parts not carrying currents—						
Shafts, spiders, cores, binders, pulleys, and gear wheels, per cent	14.1	11	12	13	9	7
Stationary parts not carrying current—						
Frames, pole-pieces, bearings, etc., per cent		8	4		8	5
	100.0	100	100	100.0	100	100

STARTING SWITCHES AND CONTROLLERS.

	Average for three years previous to 1908.	1908.	1909.
Parts carrying current—			
Resistance coils, per cent	52	52	52
Contacts and switch arms, per cent	11	10	9
Automatic apparatus, per cent	14.4	13	21
	77.4	75	82
Parts not carrying current—			
Frames, slabs, carriers for coils, springs, etc., per cent	22.6	25	18
	100.0	100	100

TABLE II.

Description of part which is believed to have failed first.	Direct-Current Motor. 1908.	1909.	Alternating-Current Motor. 1908.	1909.
Rotating parts carrying current—				
Armatures or rotors, per cent	38	39	21	23
Commutators or slip rings, per cent	29	31	2	6
Stationary parts carrying current—				
Magnet or stator coils, per cent	11	15	53	49
Brush gear and terminals, per cent	6	3	0	8
	84	88	76	86
Rotating parts not carrying current—				
Shafts, spiders, cores, binders, pulleys, gear wheels, etc., per cent	9	7	6	6
Stationary parts not carrying current—				
Frames, pole-pieces, bearings, etc., per cent	7	5	18	8
	100	100	100	100

TABLE III.

Cause of Damage.	DYNAMOS. Average for seven years previous to 1908.	1908.	1909.	MOTORS. Average for seven years previous to 1908.	1908.	1909.
Accidental, per cent	11.6	6	5	8.4	4	2
Dirt and neglect, per cent	18.2	23	20	20.8	30	26
Age and deterioration, per cent	24.1	25	16	23.1	20	14
Bad work or design, per cent	20.4	20	23	16.1	11	14
Overloading, per cent	2.5	0	1	5.0	1	1
Unascertained, per cent	23.2	26	35	26.6	34	43
	100.0	100	100	100.0	100	100

STARTING SWITCHES AND CONTROLLERS.

Cause of Damage.	Average for three years previous to 1908.	1908.	1909.
Accidental, per cent	15.6	8	5
Dirt and neglect, per cent	11.0	17	19
Age and deterioration, per cent	26.0	25	17
Bad work or design, per cent	7.7	9	14
Overloading, per cent	5.7	2	2
Unascertained, per cent	34.0	39	43
	100.0	100	100

middle wire earthed. The motor was attached to a four-ton stationary jib crane. One of the company's inspectors was sent for to find out why the craneman got a shock, as he averred he did, when he put his foot on the brake.

The inspector found that when the man, standing with one foot on the ground, put his other foot on the brake, he at the same time pressed with his knee one of the cables from the controller to the motor against the edge of an iron bracket which carried the supply cables. The rough edge of the bracket had gradually worn away the insulation which had previously guarded the copper conductor from the iron. Consequently, when the man pressed the cable against the bracket, the bracket, the crane, and the man's body formed a 220-volt circuit between the outer and the earthed middle wire of the supply. The moral is that all the ironwork of the crane should have been efficiently earthed.

2. Compound-wound six-pole continuous-current dynamo, about two years old, giving 500 amperes at 500 volts when running at 375 rovolutions per minute.

One Saturday evening, when the load was about 200 amperes, the shift engineer saw flashing, and solder thrown from the commutator lugs. He at once stopped the machine, and, finding nothing wrong, restarted it and sent for the company's inspector. The inspector called early on the following Monday morning, but was unable to make any examination, as the dynamo was running. Seeing it running well, and learning that it had so run for five hours after the stoppage on the Saturday night and for six hours on the Sunday, he left. Soon after he had gone the sparking recommenced, and the dynamo was shut down. When the inspector examined it he found some solder melted out of four of the commutator spokes, and wedged in behind them a ferrule seven-eighths inch diameter, by one-half inch deep, such as might have come off the handle of a file or soldering iron. As it could not be got out without disconnecting and bending back some of the armature conductors, it must have got in before these connections were all soldered up. The probability was that it had dropped off the soldering iron or file in use when the machine was made, two years before, or when it was repaired a short time afterwards. It is extraordinary that it had not caused damage sooner.

3. Semi-inclosed shunt-wound four-pole motor, rated to give 11.5 horsepower at a speed of 800 revolutions per minute, with continuous current at 500 volts. The motor was fixed in the fitting shop at a colliery, to drive machine tools. Soon after starting one morning the armature current went to "earth," and the fuse blew.

The fault appeared to be between the ends of the coils and the cast-iron drum for supporting the end connections to the commutator spokes. When the windings were disconnected three dead mice were found jammed between the ends of the winding drum and the commutator spokes, and a fourth inside the armature, while the ends of the windings were burnt and blackened with their blood. The unfortunate creatures, in search of warmth, had evidently crawled into the armature during the night, and in trying to escape when the motor started had been flung by centrifugal force to the periphery of the cavity behind the commutator spokes. Assuming the weight of a mouse to be one ounce, the pressure upon each from centrifugal force would be six and one-half pounds, which may have been sufficient to squeeze the blood and liquid from their bodies and thus destroy the insulation of the conductors. As a safeguard against a similar accident, the owner, at the inspector's suggestion, covered the openings in the end plates with fine wire netting.

4. Three-phase alternating-current motor, four years old, with wound rotor fitted with slip rings, giving 350 horsepower at a speed of 195 revolutions per minute, with current at 500 volts.

The motor was coupled by spur gearing to the crankshaft of an old hauling engine, from which the connecting rod had been uncoupled. Its speed was regulated by a controller of the barrel type, immersed in oil, which cut in or out resistances in the rotor circuit. The motor and controller were placed in the engine room below ground, close to the downcast shaft, and separated from the upcast by wooden doors. The room had a wood floor, and was surrounded by virgin coal. Owing to some defect, possibly a short-circuit between contacts of different phase within the controller, the oil in the box and the resistance cables leading from it were set on fire. The heat was sufficient to vaporize the oil, which burnt furiously and set fire to the doors dividing the upcast from the downcast shaft, thus short-circuiting the ventilation of the pit. The sand provided for the extinction of fires, in accordance with special rules issued in 1905 for the installation and use of electricity under the Coal Mines Regulation Act of 1887, was useless, as it would not smother a vertical or suspended cable, but the fire was put out before the coal became ignited. Whether one of the chemical entinguishers would be effective in such a case remains to be proved, but at first sight it would seem more promising than sand.

5. Three-phase alternating-current motor of 120 horsepower, running at 385 revolutions per minute, with current at 440 volts, forty periods per second from a supply company's mains. The motor was put down in 1908 to drive drawing machinery by a spur pinion, seven inches in diameter, carried on the overhanging end of the rotor shaft and geared with a wheel twenty-nine inches in diameter. It was connected to an auto-starter or transformer for reducing the voltage of the starting current.

One morning, in October, 1909, the motor refused to get up speed. On examination, one of the coils of the transformer was found burnt. The transformer was sent to a local shop to be repaired. There the company's inspector saw it, and found the insulation of one of the coils, particularly of the inner section, roasted and charred, but showing no sign of metallic short-circuits. He came to the conclusion that the damage had been done by holding the starting switch on too long when trying to start the motor. He ordered the burnt coil to be rewound.

In the meantime a starter was borrowed from the supply company, and coupled up. This worked satisfactorily till December 4, a Saturday, when the repaired starter was put back. It failed to start the motor. The borrowed starter was therefore replaced. On the following Saturday, after a diagram of the connections had been obtained from the makers, the original starter was again put in and another attempt made to start the motor, but without success. On the thirteenth the company's inspector was sent for, and arranged to attend on the next Saturday, the eighteenth. On the sixteenth and seventeenth, however, several attempts to start with the borrowed starter proved abortive, though the speed was finally obtained. On the eighteenth the inspector attended according to promise. The repaired starter was again put in, and, after some alteration of the tappings from the starter to equalize the voltage drop on each phase, was able to start the motor. After starting and stopping it some twenty times the inspector left, thinking he had over-

come the difficulty. On the following Monday morning, at 6 a. m., the motor started without trouble, but at 8:30 it again refused to get up speed. The inspector, calling a little later, found the supply company refixing the borrowed starter, and with this the motor was restarted at 1 p. m. The inspector waited till 5 p. m., when the machinery was stopped for the day, but was then unable to start the motor with the borrowed starter. He, therefore, had the triple-pole oil-switch taken in pieces and carefully examined it, tested the stator and rotor coils, and examined all connections, had the protecting shields taken off the sides of the stator, examined and gauged the air gap, and found it about one-sixteenth of an inch all around. On switching on the current the rotor began to turn slowly, and then seemed to be lifted and forced against the upper part of the right-hand side of the stator (looking from the driving end), and there to stick. On taking the bushes out of the bearings the upper halves, especially that at the driving end, were found worn sufficiently to allow the shaft and rotor to be forced into contact with the stator by the pressure exerted by the teeth of the driven wheel upon those of the pinion on the end of the rotor shaft. The bearings were adjusted, and no further difficulty in starting has been experienced.

The reason why the motor started with the borrowed starter but not with its own probably was that the former allowed a higher voltage than the latter. The reason why it started on some occasions and not on others is more difficult to suggest. Probably there were some positions of the machinery beyond the driving pinion in which the resistance to motion and consequently the pressure on the pinion teeth was greater than in others. Possibly, also, the rotor or stator cores may not have been quite circular. Whether the rotor was brought to a standstill by friction against the stator core or by loss of torque owing to weakening of the revolving field by the unequal width of the air gap is uncertain, but, be this as it may, the moral is quite clear, and it is this, that the shields over the stator windings of alternating-current machines should be so arranged by piercing or otherwise that the width of the air gap may be visible. In the case referred to neither the clearances between the shaft and its bearings nor between the rotor and the stator could be seen without partially dismantling the machine, and thus much valuable time was lost through seeking for the cause of the trouble in the dark.

6. Three-phase alternating-current twelve-pole induction motor, built in 1907, to give 350 brake-horsepower at 500 revolutions per minute, with current at 11,000 volts per phase. Periodicity, fifty per second. The stator winding consisted of 5,760 No. 13 S. W. G. double cotton-covered and braided copper-wire conductors, distributed in 144 tubes of insulating material carried in as many partly-closed slots, so that each slot held a tube containing forty conductors. The stator was probably wound by the "pin" method; that is, each tube was filled with forty steel wires, which were drawn out one by one to allow of the winding being threaded through the space left by the withdrawal. The winding was divided into eighteen coils, six coils per phase, star-connected, so that the voltage between each terminal and the neutral point was 11,000 $\div\sqrt{3}=6{,}360$, and between each coil 1,060, under normal working conditions. The rotor was of the wound type, with three slip rings and brush gear for connection to a variable liquid resistance for starting. There was no starting apparatus in the stator circuit beyond a three-pole oil-immersed switch, without any impedance, inductive or otherwise, between the supply and the motor terminals. The motor was coupled to and drove a continuous-current dynamo, giving 478 amperes at 500 volts.

It was first insured in July, 1907. In 1908 the stator windings broke down five times, first one and then another of the coils nearest the terminals giving way by short-circuiting on themselves. One of these failures occurred inside one of the insulating tubes above mentioned, the rest outside. It was at first thought that the breakdowns were due to concentration of potential across the coils at starting, and the company advised the introduction of a liquid regulating resistance between the three-phase supply and the stator terminals. This was put in in May, 1909. In July another of the stator coils gave way by short-circuiting on itself. It was then suggested that the failures were due to "surging" or resonance effect from disturbances in the supply cables, but the company could find no evidence to support the theory. An examination of the damaged coil, however, gave a clue. The cotton covering was bleached, stained green, and absolutely rotten. A test with litmus paper showed it to be acid, and analysis proved the acid to be nitric acid. The company, therefore, came to the conclusion that the cause of the repeated breakdowns was the destruction of the insulation by nitric acid formed by decomposition of the air by brush discharge from the high-tension conductors, the result of the electrostatic action being the production of a compound, N_2O_5, which, in combination with the moisture in the air, is changed into nitric acid according to the formula—

$$N_2O_5+H_2O=2HNO_3$$

The reason why the coils nearest the terminals were specially affected are: (1) The difference of potential is highest at these parts of the windings, and the brush discharge and formation of nitric acid greatest; (2) concentration of potential, which in this case no doubt broke down the rotten insulation, is bound to occur more or less across the terminal coils at starting.

Unless brush discharge can be sufficiently reduced, as has been claimed, by restricting the conductors in each slot of the stator to a single row, laid one on top of each other, the only way of preventing damage seems to be to insulate the conductors completely from air and moisture. This may be done by using formed coils thoroughly impregnated and made up solid with waterproof materials before being placed in the slots. Unfortunately this method involves open slots in the stator core, which are detrimental to induction motors, especially small ones, both as regards efficiency and power factor on the one hand and weight and cost on the other.

It has not been found practicable thoroughly to impregnate windings after being placed in position. Adequate protection can, however, be obtained for conductors wound by the "pin" method by placing them in waterproof tubes projecting beyond the ends of the slots in the stator core, and binding the projecting portions and the end windings emerging from them with a thick covering of tape saturated in some adhesive and waterproof material, to seal them completely from air and moisture.

Had this been done in the present case the motor would no doubt have run satisfactorily on the 11,000-volt supply, but the makers preferred to alter and rewind the machine for 440 volts, and to supply a step-down transformer, rather than risk further trouble from the higher voltage, and to this the owner of the motor agreed.

7. Continuous-current motor, 3.5 horsepower, 220 volts, running at 1,480 revolutions per minute. The motor drove an intermediate shaft by friction gear, and the intermediate shaft a hoist by spur gear.

The armature shaft was carried in two bearings, one and one-quarter inches in diameter, and upon one of its overhanging ends was fixed a leather-faced drum six inches in diameter and six inches broad. This drum revolved just clear of the internal surface of the rim of a cast-iron drum, forty-three inches in diameter, keyed on the intermediate shaft. The intermediate shaft was carried in eccentric bearings, by turning which the shaft and the friction drum upon it could be brought into contact with the leather-faced drum on the overhanging end of the armature shaft and pressed against it with the pressure requisite to drive the hoist. The overhanging end of the armature shaft was one and one-quarter inches in diameter. Close to the end of the bearing and between it and the drum was cut a rounded groove three-thirty-seconds of an inch deep which reduced the diameter of the shaft at this point to one and one-sixteenth inches. The distance from the center of the leather-faced drum to the groove was three and one-half inches. The shaft broke through the bottom of the groove.

Assuming a coefficient of friction of 0.2 between the leather face of the driving and the iron face of the driven drum, the pressure between the two surfaces to drive three and one-half horsepower at 1,480 revolutions per minute would be 250 pounds and the stress upon the shaft where fracture occurred 7,300 pounds per square inch. At times the stress may have been more, as there was nothing except the strength of the mechanism and the power of the man at the end of the lever which moved the eccentric bearing to prevent the pressure between the surfaces being increased indefinitely. The shaft broke through weakness, its predecessor having broken at the same place four years before. It was not properly designed.

Before closing, says the report, it may be well, in view of the number of men who have been killed or have received severe shocks recently by touching high-tension machinery, to remind all who have to clean or inspect such machinery that when well insulated and endowed with large electrostatic capacity it will conserve a charge for an appreciable and sometimes for a considerable time after the current has been cut off. No one should, therefore, attempt to handle any part until he has satisfied himself that it has been completely disconnected from the source of supply, and that a sufficient time—say ten minutes—had elapsed after the disconnection to allow the electrical charge to leak away. The stators of large high-tension alternators may possibly remain charged for even longer periods, and, therefore, even after the lapse of whatever time may be considered sufficient for discharge, the part, before being handled, should be touched lightly and quickly with the finger. Indeed, this preliminary touch is always wise.

Long cables, armored or buried underground or immersed in water, may under certain conditions hold charges for hours, and should never be handled by those who do not understand the conditions under which they become condensers and the proper methods of discharging them.

The Power Requirements of Machines and Tools.

It is well known in fitting motor drive to machine tools, says *The Iron Trade Review*, that there is a strong tendency to install too large a motor. This arises from the fact that the power requirements of the machine are seldom known with any degree of accuracy and the power necessary is often guessed at and then a liberal allowance added in order to be on the safe side. This results in considerable loss in efficiency, because the ordinary motor is most efficient at or near its designed full load. It often occurs, also, that the power required to drive a machine changes with the character of work done and the methods employed, so that a motor which was at one time the proper size may now, under different conditions, be either too large or too small. Determination of the power actually required or delivered by the motor by simple voltmeter and ammeter readings is a comparatively easy matter, and where electric drive is used motors can be changed without much trouble, and tests often show that changes would be desirable and would promote efficiency. The following changes were made as a result of voltammeter tests of the tools in a large foundry:

One forty-horsepower, six-pole motor, rated at 975 revolutions per minute light and 840 revolutions per minute loaded, driving a Root blower, one hour after starting took twenty-six kilowatts. A thirty-five-horsepower motor was substituted for this motor at 900 revolutions per minute.

One five-horsepower motor, 1,200 revolutions per minute, driving a sand mixer, when running light took 0.92 kilowatt, and when running loaded 1.84 kilowatts. This motor was replaced by a four-horsepower motor at 1,200 revolutions per minute.

One seven-horsepower motor, running at 950 revolutions per minute, driving a suction fan for rattlers, with usual load, took 2.86 kilowatts. The motor was replaced by a five-horsepower motor running at 1,800 revolutions per minute.

One thirty-horsepower motor, running at 650 revolutions per minute, driving a lineshaft and three rattlers, light, took 2.2 kilowatts; driving one rattler, loaded, 3.5 kilowatts. The motor was replaced by a 7.5-horsepower motor running at 1,200 revolutions per minute.

One 2.5-horsepower motor, rated speed 1,620 revolutions per minute, driving a double grinder, with grinder idle took 0.68 kilowatts; with two men grinding light castings it took from 1.1 to 1.8 kilowatts. A two-horsepower motor was substituted at 1,800 revolutions per minute.

One two-horsepower motor, running at 1,280 revolutions per minute, driving a thirty-six-inch exhaust fan, removing gases from core room and ovens, with normal load, took 1.8 kilowatts. It was replaced by a three-horsepower motor running at 1,800 revolutions per minute.

One 2.5-horsepower motor at 1,800 revolutions per minute, driving a thirty-six-inch band saw, a fourteen-inch bench saw and a seven-inch lathe, showed the following conditions: Motor driving shaft light took 0.66 kilowatt; driving bandsaw on two-inch pine stock, took 1.1 kilowatts; driving bandsaw with two-inch plank on bench saw, took 3.3 kilowatts. This load was so excessive that the motor speed was reduced to seventy per cent of normal. The motor was replaced by a five-horsepower at 1,800 revolutions per minute.

The original motors were all of the direct-current type designed to operate on a 500-volt circuit; the new machines were all three-phase, alternating-current motors wound for 550 volts.

Electric Power for a Paper Mill.

The National Power and Development Company, of Duluth, Minn., is planning a 1,000-horsepower hydroelectric development on the Poplar River, about ninety miles out of the city, to furnish power for a thirty-ton paper mill, etc. The estimated expenditure is $170,000, which includes the erection of the mill.

Luminous and Flame Arcs versus Open and Enclosed Arcs.

In "Luminous and Flame Arcs versus Open and Enclosed Arcs" just from the press of the General Electric Company, Schenectady, N. Y., W. D. A. Ryan gives a comprehensive, instructive and entertainingly told comparison of standards used for street illumination.

This publication is a print of the paper which he read before the National Electric Light Association at the recent meeting in St. Louis, and is very timely, treating as it does a subject that is receiving widespread attention not only from central-station men but from real-estate men, merchants and the public at large.

Charts and curves of the types of lamps treated in the article are shown and in addition complete instructions in reading them are given. This feature gives it particular value to all those interested in street illumination.

As one of the foremost illuminating engineers in the country, with the facilities of the extensive illuminating laboratory maintained by the General Electric Company, at his command, Mr. Ryan is particularly well qualified to handle the subject.

In the introduction to the paper mention is made of the importance of illumination charts and curves and the psychological opposition usually met with in their use by uninitiated persons. The following are the types of lamps studied:

The 9.6-ampere carbon open arc, commercially rated at 480 watts, equipped with clear globe and no reflector.

The 6.6-ampere carbon enclosed arc, commercially rated at 480 watts and equipped with light opal inner, clear outer globes and street reflector.

The 4-ampere luminous arc, commercially rated at 310 watts and equipped with clear outer globe, internal concentric diffuser and magnetite electrode.

The 6.6-ampere luminous arc, commercially rated at 510 watts and equipped with clear globe, internal concentric diffuser and magnetite electrode.

The 6.6-ampere vertical carbon flame arc, commercially rated at 510 watts and equipped with 26-inch concentric diffuser and light opal outer globe.

A polar curve and a hemispherical chart are shown giving the characteristics of the various types, together with instructions in reading them and conclusions to be drawn.

After this study of the characteristics of distribution and the relative spherical and hemispherical efficiencies, attention is turned to the illumination on the street, and a foot-candle curve is given.

The height of lamps above the street is studied very carefully and two charts are shown that furnish a ready means of comparing the relative candlepowers and resulting intensities for different spacings and heights of lamps.

It is stated that America has hardly advanced beyond what might be called "pathfinding" street illumination, as it is not an uncommon condition to find lamps spaced 500 feet apart and in many cases 1,000 feet apart, showing that the public has been more or less satisfied with making one lamp light from five to twenty-eight acres, or that is what it would amount to if the lamps were placed in an open space. The wattage used per linear foot of street in European cities will be commonly found to exceed American practice.

While street arcs are employed largely for linear lighting, that is, up and down the street, there are many cases where open squares, parks, etc., must be illuminated, and a chart is shown giving a comparison of the area over which the various lamps will project a given minimum light.

The values of the various types of lamps spaced at 500 and 1,250 feet respectively are illustrated in two sector plates. Broadly, the relative illuminating power of the various units for distances of 250 feet and beyond, indicating the number of lamps required of each type, if massed at one point, to equal one Boston Flame Arc, is as follows:

6.6-ampere Boston flame arc	1 lamp
6.6-ampere luminous arc	2 lamps
6.6-ampere enclosed carbon	5 lamps
4-ampere luminous arc	4 lamps
9.6-ampere open carbon	7 lamps

The Boston type of lamp referred to is the vertical carbon flame lamp recently placed on the market by the General Electric Company and is termed Boston type because the first fifty were placed in service in that city to light the principal parks and squares.

The chapter captioned "X Values" treats the specifications adopted at the 1907 meeting of the National Electric Light Association. Briefly, the "X Value" indicates the relative strength of the light as compared with a standard sixteen-candlepower incandescent lamp at a fraction of the distance. An arc lamp, for example, having an "X Value" of 4 gives the same light as a sixteen-candlepower incandescent lamp at one-fourth of the distance, all of the measurements being taken in accordance with definite specifications.

In this chapter are given the "X Values" of the types of lamps dealt with by Mr. Ryan.

In conclusion it is stated that large units should be used to light the principal streets of a city and that a large volume of light reflected from the buildings is quite as important in giving the city the appearance of being well illuminated as the amount of light projected on the street surface.

With the pole spacing used at the present time a great improvement in street lighting is possible by the substitution of the four-ampere luminous arc for the open carbon, and the enclosed carbon arc, or, if a still higher illumination is required, the 6.6-luminous arc lamp can be used in conjunction with vertical carbon flame lamps for parks, squares, or dangerous street intersections or places where an exceedingly large illumination is required.

Summarizing, Mr. Ryan says that one of the strongest features of the present conditions of the art of street lighting is that there are now available three high-efficiency units which can be operated in series on the same circuit, viz., the 6.6-ampere luminous arc for lighting the principal streets; the 6.6-ampere Boston flame arc for lighting parks, squares, and other places; the 6.6-ampere Mazda units for residential and incidental lighting.

These should materially assist in a marked improvement of street illumination.

Daytime photographs are shown of streets in Minneapolis, Detroit, Toledo, St. Louis and Boston. These were made especially for this publication by the General Electric Company's expert night photographer, Mr. Norris. Two very interesting photographs are those of Park Square, Boston, both taken at the same point, one by daylight, the other at night, the latter illustrating the illumination by the vertical carbon flame lamps hung there.

The thirty color charts and illustrations are of unusual merit and the typographical excellence does credit to the printer's art.

In anticipation of the enormous demand that there will be for this publication, the General Electric Company has had an exceptionally large edition printed.

New Electrical and Mechanical Apparatus and Appliances.

The Telechronometer.

Announcement has been made of the consolidation of the Telechronometer Company, Rochester, N. Y., and the North Electric Company, Cleveland, O. The Telechronometer Company controls both the telechronometer, a meter for the measurement of time use of the telephone, and also the automatic telephone message meter, while the North Electric Company, besides controlling patents and manufacturing general telephone equipment, controls the so-called "auto-manual telephone switchboard." The new company which is incorporated under the laws of the state of New York will be known as the Telephone Improvement Company.

The purpose of the Telechronometer system is to furnish, in a simple and practical manner, an automatic measurement at the subscribers' station of the telephone service on the basis of quantity used. In the Telechronometer system the meters are located at subscribers' stations, and in the most complete form each meter carries two register mechanisms, one for the number of calls and the other for time use. Each of these is operated by its own electromagnet, and responds to current changes in the line. No special current is employed, the changes being produced inaudibly to the subscriber in the talking or transmitter current flowing from the central office to the subscriber's station. The changes which affect the call register are produced at the beginning and end of the connection, and any intermediate changes are ineffective. The changes which affect the time-use meter, on the other hand, are produced periodically by means of special mechanisms affecting the main battery supply, and controlled by a master clock. The changes which it produces do not affect either the continuity or the voltage of the current supplied to the subscribers' stations to effect the conversation.

In operation, a subscriber having the combination meter, in removing his receiver from the hook connects the registers to the line. When the called subscriber answers the call register is set ready for actuation, and thereafter the lapsed-time register is actuated at intervals proportionate in length to the length or character of the circuit with which connection is established, and the number of times of actuation at such intervals accurately records the number of time units to be charged at the rate thus determined. At the conclusion of the conversation, when the subscriber hangs up his receiver, the call register is actuated, and both records are thereby completed. It goes without saying that either of those registers may be employed separately if desired, so that either a message rate, a lapsed-time rate, or a combination of both may be employed. A point to be particularly noted is that in every connection only the calling party's register is actuated, but reversed calls may be charged for by reversal of the connection after acceptance by the called party.

Western Electric Company to Enlarge.

At a special meeting of the Western Electric Company the directors authorized an expansion of the Hawthorne plant, aggregating $900,000. The work is likely to begin before winter. An official of the company says: "We will get additional facilities of every kind, and general increase of plant capacity to enlarge output of products."

An Electrically Operated Printing Plant.

The *Charlotte Daily Observer*, Charlotte, N. C., recently made a step toward better economy by extending the application of electric power throughout its entire plant. The large newspaper press has been driven for some time by an electric motor, which so thoroughly demonstrated its advantages that it was decided to equip all of the other machines in the same way.

The bookbinding department, which is situated on the fourth floor, turns out 30,000 volumes annually. The

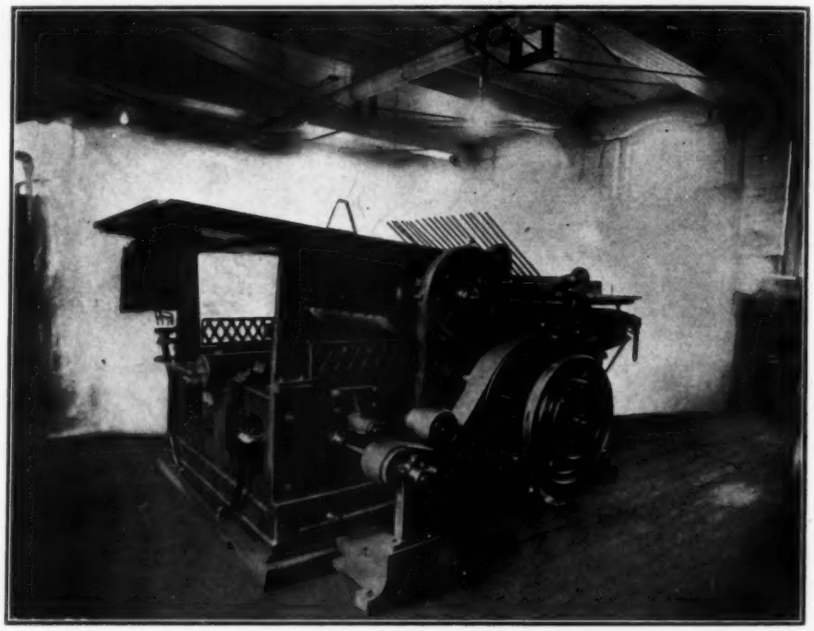


FIG. 1.—MOTOR-DRIVEN WHITLOCK PRESS.

Hickok 42 by 38 ruling machine used there can rule anything from the small "pass books" of the savings banks to the tremendous ledgers of the large commercial houses. The machine is driven by a one-quarter-horsepower motor. The absence of belts and shafting makes a neat, quiet room, and gives the impression that there is no machinery in operation. The Seybold Twentieth Century cutter is driven by a two-horsepower motor. The wire-stitcher, punch and perforator are operated by a one-horsepower motor, which drives all of them or any one or two of them.

Perhaps the most interesting installation is that on the first floor where

the large presses are running and getting out the different editions of the newspaper and the various kinds of handbills, posters, and other matter for advertising and book purposes. Fig. 1 shows the method of applying the motor drive to the No. 3 E. Pony 28 by 40 Whitlock press. The shaft of the two-horsepower adjustable-speed motor is extended to receive the pulley; an outboard bearing lends support to the shaft, giving a rigid drive. A glance at the illustration shows the motor installed under the platen of the press out of the way of the operator and yet so situated as to be easy of access for cleaning and oiling. The short driving belt is kept under constant tension by the use of an idler pulley and carrier. This press when motor driven has a range of speed covering a minimum of 1,800 to a maximum of 3,300 impressions. The controller on the machine is provided with a mechanical lock that securely holds the handle until it is released by pressing a thumb-piece. The use of this controller enables the operator to start and stop the machine, and to reverse or run at any speed between the points given. The "reverse" is a convenience to the operator when he is setting up or getting the machine ready to print.

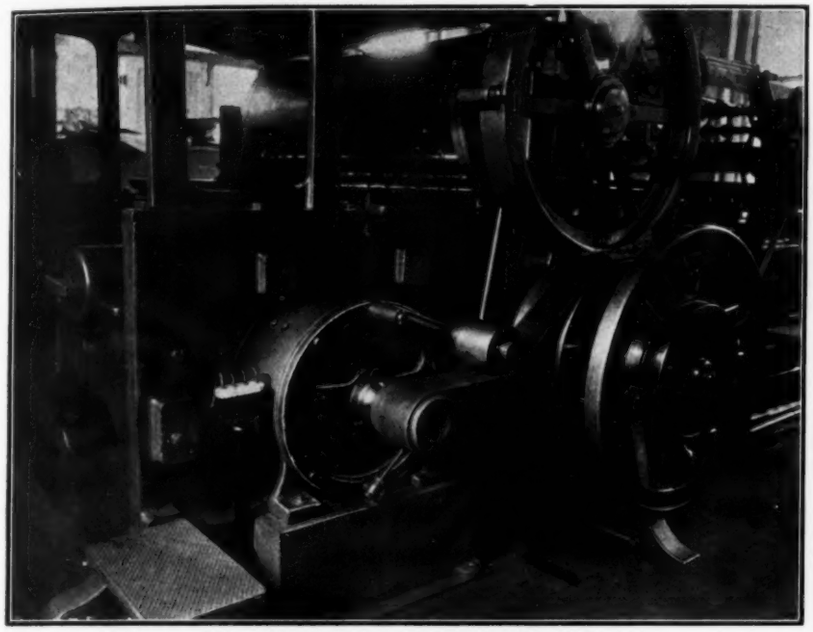


FIG. 2.—MOTOR-DRIVEN NEWSPAPER PRESS.

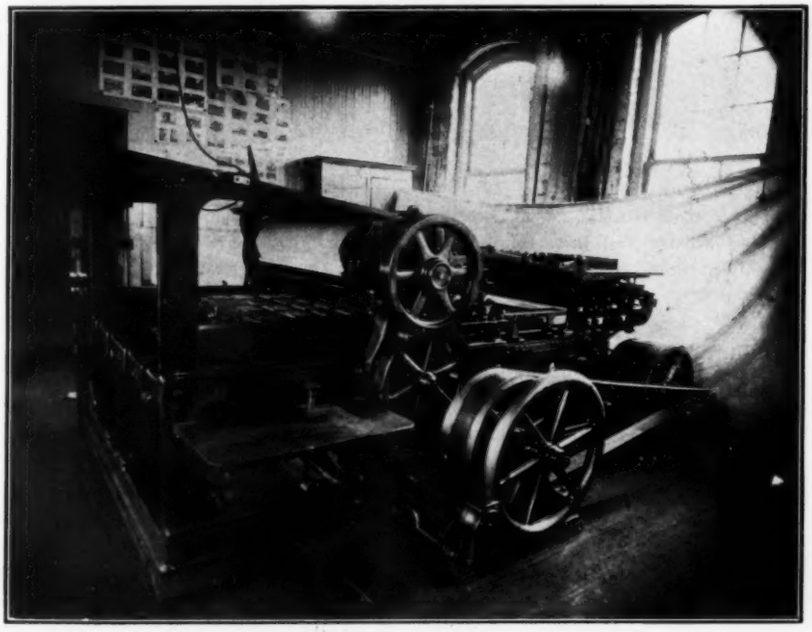


FIG. 3.—MOTOR-DRIVEN COTTRELL PRESS.

A three-and-three-quarter-horsepower motor connected to a 36 by 48-inch Premier Whitlock press, having a capacity of 1,500 to 2,400 impressions, is shown by Fig. 2. This is a larger press than the Pony, but the important points of both installations are the same.

Fig. 3 shows the method of installing a five-horsepower motor on the large No. 7, 36 by 52-inch Cottrell press, which is a slower running machine due to its size, having a minimum of 1,500 to a maximum of 2,400 impressions. As an illustration of what this method of drive has accomplished, the printing of sheets 18 by 24, sometimes called half sheets, is typical. Under the old belting system, it took six hours to get ready and print 5,000; now this work is done in three hours. On heavy forms and the better class of work, not quite so good a showing is made, yet even here it has been possible to cut the time one-third. This shortening of time is due to the fact that when everything is adjusted and in running shape, the operator can increase slowly to the highest speed which he thinks is best, simply by moving the controller handle. Previously, with the old countershaft and pulleys, it was necessary to change belts or cone pulleys or else run the machine at a standard speed regardless of the size of the sheet. It is a well-known fact that few operators care to keep changing belts, whereas with the motor drive the ease with which he can "speed up" is an incentive to do so.

The electrical equipment was supplied by the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa.

Electrical Water Purification for Minneapolis.

The Minneapolis City Council is investigating the cost and efficiency of the Johnson process of water purification by electricity, and has appropriated money to assist in carrying out experimental work. The city bacteriologist will report as to the value of the process. Z.

Combination Fuse and Service Boxes.

The Johns-Pratt Company, Hartford, Conn., through its sole selling agents, the H. W. Johns-Manville Company, of New York, has recently placed on the market a very large and complete line of Noark fuse and service boxes, of both weatherproof and watertight types. These various boxes and fittings have been given approval by the Underwriters' Laboratories, and consist of boxes for 250 and 600 volts, all capacities, for two and three-wire systems and accommodate Noark inclosed fuses of the national standard types.

Figs. 1 and 2 show the construction of watertight boxes which may be used for house service work, as well as aerial and subway work in connection with iron pipe conduit. Where used for subway work, cable sleeves may be inserted into the various types of interchangeable conduit fittings for the purpose of making wiped joints on lead-covered cables.

FIG. 1.

Fig. 1 shows the fuses in circuit, and Fig. 2 illustrates fuses withdrawn from the circuit by means of a handle on the outside of the cover which simultaneously actuates three-fuse carrier hooks within the box, thus withdrawing the fuses and performing the function of a switch.

Each end of Noark fuse and service boxes is provided with a large oval boss having a machined surface which is drilled and tapped to accommodate various types of fittings, and the porcelain bushings extending therefrom are fastened in the box with soft lead washers, forced into place under heavy pressure, which permanently holds them in position.

The larger sizes of these boxes are provided with galvanized chains to prevent the hinges from becoming broken from careless manipulation. All boxes

FIG. 3.

are provided with sealing arrangements.

Interchangeable conduit fittings are shown in Figs. 3, 4, 5 and 6. Rubber gaskets are recommended between the fittings and the boxes where construction requires water or gastight joints.

The weatherproof line of fuse boxes differs from the watertight line in that they are intended for use where an absolutely water and gas tight box is not

FIG. 4.

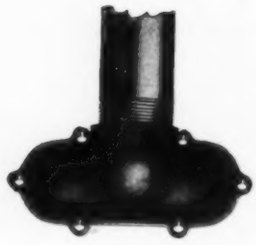


FIG. 5.

required. All of the weatherproof boxes are constructed to accommodate standard fittings specially made for them.

Cross-Channel Wireless.

Passengers by the Dover-Calais and the Folkestone-Boulogne turbine steam-

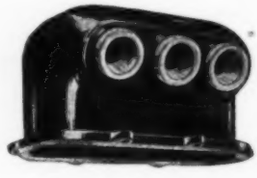


FIG. 6.

ers may now send wireless messages to any British island address at a cost of six cents a word, with a minimum charge of sixty cents a message.

Trackless Trolley Line in America.

The first commercial trackless trolley in America has lately been installed near Los Angeles, Cal., for the purpose of handling passengers from the lines of the Los Angeles Pacific Railroad Company to "Bungalow Land," a real estate subdivision in the hills northwest of the city.

The road traversed is mostly curves, there being only 1,000 feet of tangent in the mile and one-half, the grade ranging from five per cent to twelve per cent, hence this road is well suited to test the practicability of the system.

Transportation, previous to the installation of the trolley system, was via automobiles, but these proved too uncertain and owing to the grades the maintenance was excessive, besides such a transportation system lacks the

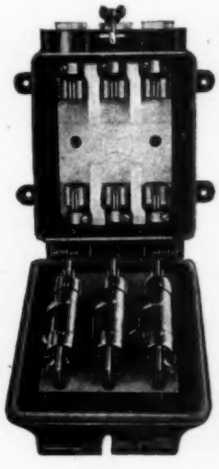


FIG. 2.

substantiability necessary to an enterprise of this character.

The expense of constructing a track and overhead for a regular system would have been excessive, as the road is a pass in the hills and would have ruined the road for automobiles which pass over this route in considerable numbers.

For these reasons the trackless trolley seemed to be the logical solution, combining simplicity, reliability, economy in first cost and low operating charges.

The old gasoline-motor busses, two in number, were stripped of the original motive power and fitted with two especially designed and constructed motors of fifteen-horsepower rating, 500 volts, each motor driving one rear wheel by chain, thus eliminating the

differential. The control is by means of a series-parallel controller mounted on the dash, to the left of the steering wheel, the reverse switch being separate under the driver's seat and operated by a handle to the right of the wheel. The usual expanding and contracting brakes are fitted as in a regular automobile.

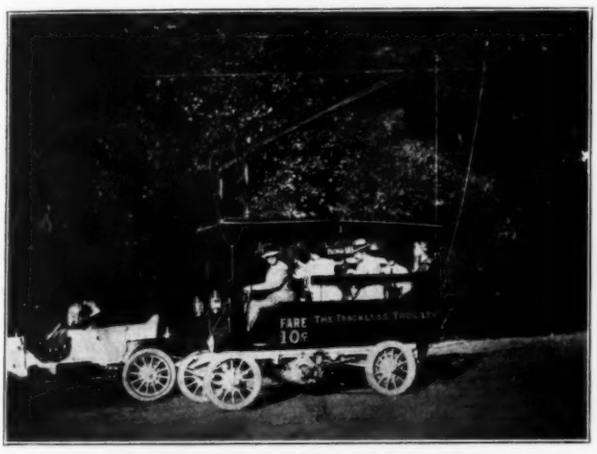
The trolleys are mounted forward on the roof of the bus, approximately twenty-four inches back of the front axle and spaced forty-eight inches apart, which is also the spacing of the trolley wires. The poles themselves are of wood, fifteen feet long, and carry a special swiveled form of collector at the end, which is arranged to slip off without damage in case the pole should leave the wire.

These trolleys allow a total variation of eleven feet each side of center on the roadway, and at slow speed will operate when making a horizontal angle of seventy-five degrees with the trolley wire and will also allow the car to be completely reversed in direction under the wires without change, although it is, of course, necessary to turn the poles after the car has turned and before it can proceed because the poles are crossed and projecting forward of the car.

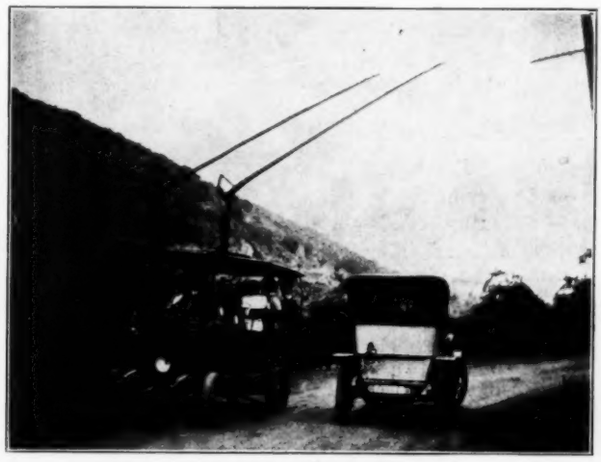
The trolley wires are of grooved copper suspended from pipe arm brackets fastened to telephone poles along the roadway, these being sometimes on the right and sometimes on the left hand side of the road; the cars, however, always obey the rules of the road and pass to the right of approaching vehicles regardless of the location of the trolley wires.

A speed of twenty-five miles per hour is possible on the straight-away, but ten miles per hour is all that is desired or used on the curved portions of the line.

The system is owned by the Laurel Canyon Utilities Company of Los Angeles, of which Charles S. Mann is president. The line and electrical apparatus was designed and furnished by R. W. Shoemaker, electrical engineer, also of Los Angeles.



VIEW OF TRACKLESS TROLLEY CAR.



CAR PASSING AN AUTOMOBILE.

A Unique Catalogue and Data Sheet on Electric Heating Devices.

The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., in introducing its new line of heating devices, has prepared a comprehensive catalogue which describes in detail the various devices which enter into its system of electric heating. The catalogue is well illustrated, and there is sufficient text to give one a good idea of the mechanical and electrical features of each device. The unique feature of the book, however, is the data sheet, which contains full information concerning each article, giving the price, weight, dimensions, time required to heat, and cost of operation.

The cost of operation depends, of course, on the cost of current, which will vary in different localities. This cost of operation will also be governed to a considerable extent by the care with which the user handles the device. In the case of a flat iron it may soon be discovered that it is not necessary to leave the current on continuously, but as soon as the iron is thoroughly heated the current may be shut off until the iron shows signs of cooling. In this way an hour's ironing may be done without using current for more than one-third of the time.

Electricity on Farms.

In a recent issue of *Electrotechnische Zeitschrift*, Harald Wallam gives the following statistics of current consumption per 700 acres per annum on large electrically operated farms: For lighting, 0.6 to 1.0 kilowatt-hour; small motors, 1.0 to 1.5 kilowatt-hours; threshing, 2.5 to 3.0 kilowatt-hours; plowing, 21.0 to 24.0 kilowatt-hours.

A New Alloy.

At the San Francisco meeting of the American Chemical Association, July 16 last, Elwood Haynes, president of the Haynes Automobile Company, Kokomo, Ind., told of some researches he had been making during the past few years to produce alloys of cobalt and nickel with chromium primarily intended for use in spark plugs.

After some experimentation he finally took a standard mixture of seventy-five per cent cobalt and twenty-five per cent chromium in a specially prepared refractory crucible, and melted out an alloy to a perfect fluid. By the use of a purifying agent, discovered after some research, he succeeded in producing a tough malleable metal comparable with razor steel, with an elastic limit of 79,000 pounds to the square inch, tensile strength 96,000 pounds, elongation three per cent, and modulus of elasticity about equal to that of steel. By mixing the alloy with small quantities of other substances, its properties were considerably modified, and brittle alloys were ob-

tained, which would readily scratch quartz crystal. Again, by reducing the chromium and adding certain other materials, practically proof against nitric acid, a softness and malleability were obtained which enabled the material to be worked cold, the hardness being comparable with that of mild untempered steel. Between these extremes a great variety of combinations were obtained which were suitable for various purposes.

The principal property of the new alloy, besides those mentioned above, is its practical noncorrodibility under the action of oxygen, moisture, acids, and alkalies. It is suggested for use in making culinary utensils and cutlery, and for the manufacture of standard weights and measures, in the latter case to replace the expensive platinum-iridium alloys now in use. Its cost is stated not to be excessive.

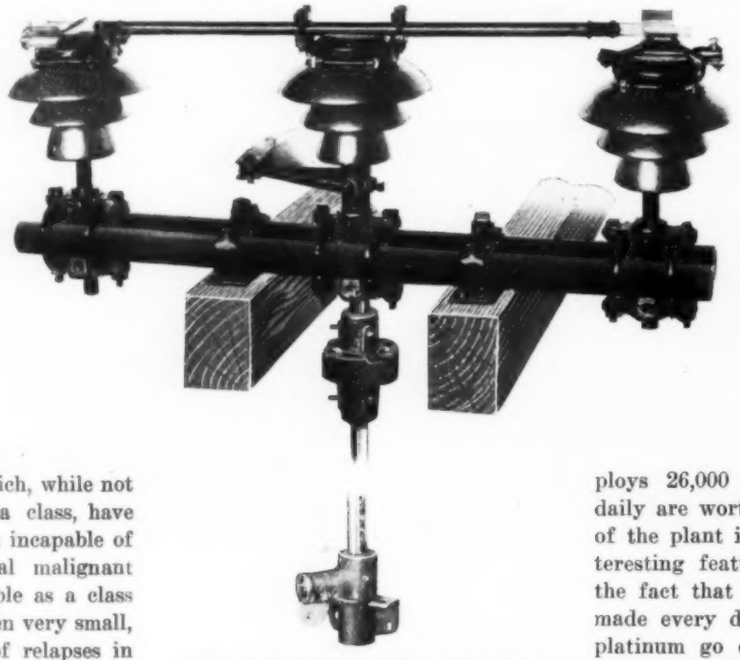
Electrolytic Treatment for Cancer of the Mouth.

For a generation or thereabout electrolysis and other methods of electrotherapy have made distinct headway against forms of tumor which, while not technically malignant as a class, have been progressive and often incapable of being operated on. Actual malignant growths have been amenable as a class to such treatment only when very small, as in the earliest stages of relapses in localities where wide incision is impracticable. Occasional results are obtained where the prospects under such treatment would not have been called in the least encouraging. A case of this kind has been recorded in the *Deutsche Medizinische Wochenschrift*. The author states that he had to do with a very far advanced case of epithelial cancer of the nasal portion of the pharynx with numerous glandular changes on both sides of the neck. Three months after surgical removal, the growth suffered a violent relapse. The recurrence was first curetted and then treated for thirteen sessions with electrolysis, with the result that the tumor cells appeared to have lost their power to multiply. The case was reported fully cured.

High-Tension Switches.

It is now acknowledged that pole-top switches are an essential feature of every well-designed transmission system, and many have been installed by companies having experience in handling power lines.

The poletype switch, illustrated herewith, is being placed on the market by the Pacific Electric and Manufacturing Company, San Francisco, Cal., and is said to be the only one with two breaks per pole. It has many other commendable features, among which may be mentioned the fact that it will open all leads of a circuit at once, from the ground, although being of the simplest possible form.



THIRTY-THOUSAND-VOLT POLE-TOP SWITCH.

The pole top switches as now manufactured by the company are equipped with an all-metal arm, to supplant the wood arms heretofore furnished. This arm is perfectly rigid and readily adjustable to either a wooden frame or a steel tower, with the added advantages of indestructibility and independence of the action of the weather.

As in the older type, the levers and couplings are fastened with taper pins throughout, and, according to the manufacturers, no special work is required in the field. The control-shaft coupling is adjustable to any angle and the switch can be locked in the open or closed position.

A removable wooden handle is supplied, and the switch can be freely handled in any weather. The arms can be extended to hold fuse fittings, or dead-end insulators in the event of a heavy strain.

This company is also manufacturing and placing on the market a line of oil switches which have met with wide approval.

These switches have a one-piece cast-iron tank which is guaranteed not to leak. The contacts are rigidly alined, all parts being supported by the cover of the tank. The fixed contacts can be quickly removed and replaced by the freeing of one large nut and the contact and terminal units can be removed by taking out two cap screws.

The Wonders of the Western Electric Company.

Under the above title an article appears in the *Telephone Review* for September by Herbert N. Casson, which describes the plant of the company in Chicago, gives something of its history, and tells the story of its remarkable growth.

This company employs 26,000 men, and its products daily are worth $200,000. The capital of the plant is $70,000,000. Other interesting features are given, such as the fact that 5,000 electric lamps are made every day and 1,000 pounds of platinum go each year into the telephone transmitters.

Electrification in New Zealand.

The Hon. R. McKenzie, Minister of Mines and Works in New Zealand, recently stated that there were water powers in New Zealand capable of developing 4,000,000 horsepower. He said that at present all of the industries and railways in that country could be operated by 250,000 horsepower. He was of the opinion that electricity would shortly revolutionize both the quartz and alluvial mining and that the time was close at hand when all the railways would be worked electrically. Already it has been decided to work the Arthur's Pass section of the Midland Railway by electricity.

Current Electrical News

GREAT BRITAIN.

(Special Correspondence.)

LONDON, OCTOBER 15.—The courts are once again engaged with the question of metal-filament lamp patent infringement. The particular action is an appeal by Messrs. Bergmann, of Berlin, against a judgment last March that they had infringed a patent belonging to the "Z" Electric Lamp Company. This latter company has a patent the chief object of which is said to be the removal of the last traces of carbon in a tungsten filament by the use of phospham and the consequent prevention of blackening of the bulbs. The case for Messrs. Bergmann is that the blackening of bulbs of metal filament lamps is not due to carbon at all but to the tungsten, and that even if the use of phospham did remove the carbon which is denied, it would not prevent blackening. The use to which they put phospham, they say, is that by painting the stem of the lamp with it they produce phosphorus gas which improves the insulation of the lamp and gives a better product generally. The judgment of the court below was that even if this were so the fact that the use of phospham produced a different result to that anticipated—for the judge held that it did remove carbon—was sufficient to warrant him holding that the patent had been infringed. The court of appeal is now involved in a maze of chemical formulas in an endeavor to arrive at a decision as to whether the phospham used by one of the parties is phospham as understood and used by the other.

The last has apparently been heard of the famous libel action in connection with the experiment of the London County Council with the G. B. surface-contact system in the Mile End Road. The experiment was the occasion of a considerable amount of political criticism at the time on the part of opposition newspapers in which, of necessity, the name of the system entered largely. The owners regarded these statements as a libel upon the efficiency of the system and took proceedings. The newspapers have now, without the action coming into court, agreed to pay a substantial sum in damages and to make a public apology. They state that their criticism was not directed against the G. B. system *per se* but against the modification of it which was installed by the London County Council who refused to allow the inventors to supervise its construction. Full prominence is given to this fact, which has been the complaint of the inventors all through.

An interesting development of municipal electric supply happened at a local government board inquiry last week. The South Shields Company was asking for a loan of some $50,000 for putting in a new plant at its electricity works, but the North Eastern Railway Company and a large dock firm, whose rateable value in the borough amounts to no less than $330,000, opposed and showed to the government inspector that by taking a supply from the local power companies it could be obtained more cheaply than if the corporation did the additional generation itself. Fortunately the corporation finally saw the wisdom of the proposition and it is now being discussed with the power company.

Reports are in circulation to the effect that the electrification of the main line from London to Brighton will be undertaken by German manufacturers, and if necessary, it is said that continental banking firms will assist in raising the $10,000,000 or $15,000,000 capital which would be necessary. The railway company, however, has not gotten quite so far as this, although the conversion of the main line to Brighton as an extension of the existing south London single-phase line has long been contemplated. G.

CONTINENTAL EUROPE.

(Special Correspondence.)

PARIS, OCTOBER 13.—Owing to the extensive use of electric traction on the Southern Railroad system in the Pyrenees region of France, the company is now taking measures to secure the needed power, and it will erect several turbine stations in the mountain district. One of these plants is located at Eget, and it will use a head of water of 250 feet. An artificial lake will be formed by constructing a dam forty feet in length, and the offtake canal will be about two miles long. A second electric plant will be built on the Soulon, and here a fall of forty-five feet is to be used. About 25,000 horsepower can be secured in this latter plant. A third station will be erected at Soussouecu, and it is probable that the Arbouste Lake will serve as a regulating reservoir.

The question of using the power of the Rhone in order to secure a supply of current for Paris is being actually considered at present. The proposed plant will be located at Genissat, not far from the Swiss frontier. A commission has been lately appointed to examine the matter.

A new electric plant will be erected at Lille, France, by the Northern Railroad Company, as the current given by the present station is insufficient for the lighting of the extensive railroad stations and yards. I also note electric lighting projects at Fresnes, Montfermeil and Montrevel.

There is a project on foot for a standard gage electric railroad from Cologne to Kassel, Germany. The Bergmann Electric Company is interested in the enterprise.

The tramway line of St. Margarethe Island is the last one in Budapest to use animal traction, but now it is to be operated on the electric system, according to a recent decision of the municipal council. The overhead trolley will be used here. An electric railroad line is to be run in the Moldau Valley region, Austria, and the work will be carried out by the Vienna Siemens-Schuckert firm. Starting from the station of Zarttesdorf on the Hinz-Budweis railroad line, the electric road will run by way of Hohenturt to the terminus at Hippnerschwebe. An electric plant located near the starting point will furnish direct current at 1,200 volts for operating the line.

Prizes are to be awarded in 1911 by the Industrial Society of Mulhausen, Alsace. Among those which concern the electric industries I note a silver medal for a new application of electricity in the dyeing-bleaching or cloth-printing industry. A medal is awarded for a system of working a printing press, a paper machine or other which has a variable speed, by a three-phase motor using a constant voltage and frequency. Another question is a study of the application of mechanical as compared with electric drive for various kinds of factories, also that of electric power supplied to home workshops.

In the region of Marseilles there will be installed an electric tramway on the St. Antoine route to the Hanciers railroad station and the present steam road from this point to Martigues will be changed over to electric traction. An electric line is also to be run from Martigues to Port De Bouc.

The concession for the electric lighting of various quarters of Constantinople has been granted by the government to the Ganz Electric Company of Budapest. A syndicate has been formed by this company together with the contracting firm of Giros & Houcher, of Paris, and the French Societé Havraise. Both these firms have branches at Constantinople. A. de C.

CANADA.

(Special Correspondence.)

OTTAWA, ONT., OCTOBER 22.—The Lanark & Carleton Counties' Telephone Company is making application for increasing its capital stock, owing to the fact that the company has expanded so rapidly within the past year.

It is reported that the Montreal Light, Heat & Power Company will shortly apply for the right to increase its capital stock from $17,000,000 to either $20,000,000 or $25,000,000. Ever since the combine was created in 1901, what little financing the concern has done has been in the shape of bonds.

The delay in work on the municipal power plant of the city of Toronto, due to the obstructive tactics of the Toronto Electric Light Company, will probably prevent the city from taking over the street lighting immediately upon the expiration of the company's contract with the city at the end of the year. An extension of the company's charter is not involved, and the city can either use gas light or buy power from the company from day to day.

It is stated that the Winnipeg Street Railway Company will shortly make an issue of from $500,000 to $1,000,000 of new stock. The last issue was made in 1907, when $1,500,000 was issued, the shareholders paying $66.66 and the balance of $33.33 being paid by the company from the surplus account. As the present outstanding capital is $6,000,000, an issue of $1,000,000 new stock would make the rights on the old stock worth over $16 a share. The company is at present paying a ten-per-cent dividend, but is said to be earning in the neighborhood of twenty per cent.

The efforts of the Canadian Power Company to bring into the city of Montreal electric power supplied from Chateauguay may receive a temporary set back through the laws governing the sale of Indian reserve lands. Transmission lines must cross the Caughnawaga Indian Reserve, yet the Indians have no power to sell the land to the Canadian Company, according to the provisions of the grant. The land the company wants is about a hundred feet in width only, and it is prepared to pay a good price for it. The Indians are willing to sell. They want the cash and they want the power that will be brought to the reserve by the new company, and yet they cannot legally alienate their lands. W.

IMPORTANT DEVELOPMENTS.

(Special Correspondence.)

DEVIL'S GATE PLANT COMPLETED.—The 5,000-horsepower plant at Devil's Gate, Weber Canyon, Utah, was recently completed and turned over to the Utah Light & Railway Company. Power is transmitted at 40,000 volts to Ogden and Salt Lake City.

CHIPPEWA VALLEY DAM NEAR COMPLETION.—The large concrete dam of the Chippewa Valley Construction Company across the Red Cedar river at Cedar Falls, Wis., has been practically completed. This dam, which is 550 feet wide and has a head of fifty feet, will develop 15,000 horsepower. The power will be delivered to the Chippewa Valley Electric Railway, Light & Power Company, which will distribute it to the town of Menomonie and to other points in the Chippewa Valley. The cost of the project, including the dam, embankment at one end, the power house and other machinery will be about $500,000. The dam will cost about $200,000. Work was started last March. The lake which will be formed by the dam will be fourteen miles long, destroying Lamb's Creek Falls above Cedar Falls. The construction work is in charge of H. S. Richards of New London, Conn. M.

PLANS FOR MEXICAN DEVELOPMENT.—A company composed largely of Denver, Colo., capitalists, have completed plans for the construction of three power plants in Mexico. About $6,000,000 will be invested in the project and it is expected that 300,000 horsepower will eventually be generated. The power project on Rio Mayo, in Sonoro, Mexico, includes a dam 170 feet high, 260 feet long at the top and a reservoir capacity of 10,280,000 cubic feet. The Rio Humaya project includes a dam 223 feet high, 708 feet at the top and a reservoir capacity of 11,384,500,000 cubic feet. The Rio Santiago project includes a dam 215 feet high, 145 feet long and 9,360,000,000 cubic feet capacity. The transmission lines will extend from Guaymas to Santiago, a distance of 1,200 miles. Twenty cities along the west coast of Mexico, eight of which have electric street car systems, will be supplied with power as well as the railroads and mines.

TO DEVELOP POWER IN CALIFORNIA.—The San Joaquin Light & Power Company, operating hydroelectric power plants and distributing systems in the San Joaquin Valley, has placed on file a trust deed covering its property as security for $25,000,000 in bonds. The proceeds will be used partly in refunding outstanding bonds and partly for the development of power in Mariposa, Madera, Tulare, Kern and Kings Counties, Cal. Of the sum secured, $1,500,000 will be immediately available for the completion of the San Joaquin power plant and for the completion of the Bakersfield steam plant in Kern County, recently secured by the purchase of the Power, Transit & Light Company, of Bakersfield. At the time the Bakersfield plant was taken over, the Merced Gas & Electric Company, of Merced, Cal., was also purchased, and a portion of the money now available will be used in the construction of high-tension lines connecting all of the Company's plants. The distance between the Company's plants at Merced and Bakersfield is 200 miles, the other plants lying between these two. The plant at Crane Valley in Fresno County has been completed, adding 10,000 horsepower to the Company's output, which is now 30,000 horsepower. The completion of the San Joaquin plant will add another 10,000 horsepower and the Bakersfield plant will add 2,750 horsepower. A.

LIGHTING AND POWER.

(Special Correspondence.)

BUFFALO, MINN.—New machinery is being installed in the electric light plant. C.

WYMORE, NEB.—The installation of a municipal electric light plant is being agitated. C.

TEXAS CITY, TEX.—The Texas City Company is soon to establish an electric light plant. P.

WILTON, WIS.—A franchise has been granted to Carl Vogel to install an electric light plant. C.

CHINOOK, MONT.—S. W. Swenson has applied for franchise to install an electric light plant. C.

CHARLES CITY, IOWA.—The city will shortly commence the installation of curb cluster lights. C.

ANOKA, MINN.—Bonds for $8,000 for improvements in the light and water plant have been voted. C.

ASHDOWN, ARK.—John P. Logan, of Grannis, Ark., has applied for an electric light franchise here. P.

VERNON, TEX.—The Vernon Light & Power Company contemplates doubling the capacity of its plant. P.

COLUMBIA, MO.—This city has voted bonds to cover extensive improvements to its electric light plant. P.

ELLIOTT, IOWA.—R. O. Prather, of Griswold, has applied for a franchise for an electric light and power plant. C.

BRAINERD, MINN.—The water and light board recommends the immediate installation of a temporary lighting plant. C.

FAIRVIEW, S. D.—A local milling company is developing water power and will engage in lighting and power work. C.

CHADRON, NEB.—Kass Klingaman recently purchased the business of the Chadron Electric Company from Wm. Ellis. P.

HASTINGS, MINN.—The electric power company of Clifton is setting poles for electric light for Hastings and Prescott. C.

SALLISAW, OKLA.—This city has voted bonds for $16,000 for the establishment of an electric light plant. P.

McPHERSON, KAN.—This city will hold an election in November to vote electric light improvement bonds. P.

COUNCIL GROVE, KANS.—The J. R. Rhodes Lumber Company has purchased the local electric light plant and will improve same. P.

TYNDALL, S. D.—Work has been started on the construction of a power house for the new electric light system. It will cost $5,130. C.

TACOMA, WASH.—Blows & Tuell received the contract for the substation for the Nisqually power plant. The cost was about $104,000. C.

MILES CITY, MONT.—The contract for the foundation for the engine and generator at the electric light plant has been let to N. K. Nybe. C.

COLERAINE, MINN.—The Oliver Iron Mining Company is planning to supply its surplus electric power to manufacturers and surrounding towns. C.

SEATTLE, WASH.—A contract has been let to the Novelty Incandescent Lamp Company for $60,000 worth of incandescent lamps for lighting this city. A.

FARMINGTON, N. M.—The electric light plant here has been purchased by R. W. Knowles who, with his associates, will spend about $100,000 in improvements. A.

GENEVA, ILL.—A 200-kilowatt generator has been purchased by the city from the Gregory Electric Company, of Chicago, and installed in the lighting plant here.

RAPID CITY, S. D.—The Rapid City Electric & Gas Light Company will shortly erect a plant with cement floor. The company has also started the extension of its lines. C.

DETROIT, MICH.—With a view to extending its business in the western suburbs, the Edison Illuminating Company has applied for a thirty-year franchise in Eunice County.

GRAND FORKS, N. D.—The Red River Power Company will expend approximately $100,000 in improvements and additions to the electric light and gas plants by January 1. C.

LITTLE FALLS, MINN.—The Commercial Club is agitating the installation of electric signs along the right of way of the Northern Pacific Railroad for advertising purposes. C.

SANTA FE, N. M.—Homer W. Schoenfield of Almagordo, N. M., has applied for water rights of Tularosa Creek in Otero County, for the operation of a power plant to cost $15,000. A.

BELLOWS FALLS, VT.—The Southern Vermont Light & Power Company has been incorporated with a capital of $50,000 by James P. Meany, Daniel Connors and George M. Faulkner.

CHISHOLM, MINN.—The Mesaba Range Power Company, capital $250,000, has been incorporated to develop power at the Sturgeon Lake dam. A. L. Ober is president of the company. C.

WILTON, WIS.—The Wilton Light & Power Company has been organized at this place with a capital stock of $5,000. The incorporators are Carl C. Vogel, W. F. Vogel and C. A. Vogel. M.

VANDALIA, ILL.—Bids for the sale of $10,000 worth of six per cent municipal electric light and waterworks bonds will be received until November 14 by George L. Whiteman, city clerk. Z.

SEATTLE, WASH.—An auxiliary city power plant to be located on Lake Union will be built next year. A power house is to be built and 2,000 additional electric horsepower supplied this city. A.

OTTUMWA, IOWA.—A one-story brick and concrete building is being erected on South Jefferson Street for a power plant for the Ottumwa Railway & Light Company. It will be 112 by 34 feet in size. C.

NEWTON, IOWA.—The County Board let the contract for the installation of an electric plant at the county farm to the Monarch Machine Company, of Des Moines, for $1,150. Work will be started at once. C.

YOE, PA.—A council was held recently between the city officials and the superintendent of the York & Windsor Electric Company, with a view to lighting the city. The streets have been in darkness.

LOS ANGELES, CAL.—The Board of Public Works has announced in behalf of this city that it will supply the town of Independence, Inyo County, with electric power from a plant on the aqueduct. A.

UPLANDS, CAL.—The Pacific Light & Power Corporation has been granted a fifty-year franchise to erect poles and string wires for the transmission of electricity along the easterly side of Orange Avenue in this city. A.

SIDNEY, NEB.—A. S. Hardy and Gladys Le Seuer a short time ago purchased the remainder of the stock of the Sidney Electric Company from Chas. Callahan. The new owners are planning extensive improvements.

AUSTIN, MINN.—The electric light, power and water board

let the contract to the Allis-Chalmers Company, of Milwaukee, Wis., for the installation of a 750-kilowatt generator for $17,500. It will be installed next spring. C.

CARSON CITY, NEV.—The Brunswick mill and power site with water rights has been taken over by the Western Smelters Corporation. A power plant will be built early next year to supply power to the new smelter. A.

PHOENIX, ARIZ.—L. C. Hill, of the Water Users' Association, reports that matters will soon be adjusted for the building of the electric-light works for which the farmers in this vicinity have agreed to advance $900,000. A.

EATON, IND.—The Eaton Electric Company, Eaton, Delaware County, has incorporated with a capital stock of $1,000 to supply municipal and domestic lighting. The directors are R. E. Breed, H. L. Finley and F. B. Ball.

HUNTERS, WASH.—M. W. Thompson has secured water right on the upper Hunter's Falls and has leased a power site from J. B. Cameron. Mr. Thompson recently purchased the power plant here and will transfer it to the Falls.

EPHRATA, WASH.—It is proposed to install an electric light and power plant here or to secure power from Wenatchee. E. P. Luedtke, of Seattle, is promoting the formation of a company with $10,000 capital, to build a suitable plant.

PECOS, TEX.—The managers of the Pecos Light & Ice Company have decided to enlarge their present plant to a sufficient capacity to meet the increasing needs of this city. It is understood that they have already purchased new machinery.

WAREHAM, MASS.—The Marion Gas and Electric Company is considering the extension of its system to Bourne. Already the power plant supplies street and house lights as far as Onset, but the further extension has been agitated for some time.

CREIGHTON, NEB.—After three weeks of darkness, caused from a burned-out dynamo, the Creighton Electric Light Company has its plant in running order. A new dynamo much larger than the one formerly used has been installed and the service is much improved.

BALTIMORE, MD.—The Consolidated Gas, Electric Light & Power Company announces that it will bear one-half the expense of a building to be used by small manufacturers. The building will cost about $200,000 and will be completely equipped with electric power.

NEWARK, N. J.—A resolution was recently introduced into the City Council advocating the extension of the City Hall lighting plant to include such public buildings as it can supply. The measure carried. The step has brought up a controversy regarding the municipal ownership of public utilities.

ST. JOHNS, MICH.—The new equipment of the electric light and power plant was put in service a few weeks ago. There are now two 360-kilowatt 2,300-volt generators which were furnished by the Allis-Chalmers Company. This equipment was entirely paid for from the earnings of the old plant.

CHARLOTTE, N. C.—The Mount Holly Cotton Mills Company, of Mount Holly, has completed its installation of equipment for driving its plant by electricity instead of steam. The mill is a modern one, containing about 3,000 ring spindles and accompanying equipment for the production of cotton yarns.

SANTA BARBARA, CAL.—The Santa Barbara Gas & Electric Company has commenced work on a high-tension 10,000-volt line from its power station on Castillo Street to a substation in Montecito, at the cost of $10,000. As soon as a site for the substation is decided upon, a concrete station house will be built. A.

ARCOLA, ILL.—George Hallauer and William Moore of the Arcola Ice and Cold Storage Company have purchased the Arcola electric light plant and will operate it in the future. New machinery probably will be installed, the city council having promised a franchise and a contract for lighting the municipality. Z.

MOLINE, ILL.—The People's Power Company of Moline has closed a contract to supply power to Deere & Company and its affiliated companies, which include Deere & Mansur, the Union Malleable Iron Company, Moline Wagon Company, Marseilles Manufacturing Company and the Velie Engine Company. Z.

KLAMATH FALLS, ORE.—The Klamath Falls Light & Power Company is making preparations to triple its power at the Moor plant. The plant is to have a capacity of 10,000 horsepower. The company will also do away with the wooden flume to the power wheel and substitute iron pipe from the ditch to the plant. A.

LEWISTON, ME.—The New Hampshire Water and Electric Power Company has been incorporated at Portland, for building, operating and maintaining water works, systems for power and other purposes, with $200,000 capital stock. Officers are: President, Charles E. Gurney; treasurer, John H. Ridge, both of Portland.

ALAMOGORDO, N. M.—The Alamogordo Water Power Company will install a hydroelectric plant of 800 horsepower capacity in Box Canyon, near Highrolls, and will construct transmission lines into the Sacramento Valley for the purpose of furnishing power for irrigating, pumping plants and manufacturing concerns. power for irrigating, pumping plants and also to manufacturing concerns. D.

JEFFERSON, IOWA.—Mrs. John Gray, holding a third mortgage aggregating some $14,000 against the property of the Jefferson Light, Heat, Power & Water Company bought the property when it was sold under foreclosure proceedings begun by her. The plant is now said to be in good condition and doing a good business with a bright future. Z.

SPRINGFIELD, ORE.—The Springfield Electric Light Plant is to be enlarged this winter to double its present size and a substation is to be built. The increased plant will contain the new 2,000-kilowatt turbine generator and two additional boilers with a capacity of 500 kilowatts each. Construction work is expected to begin in January. A.

VALDOSTA, GA.—The Consolidated Power and Light Company, which took over the property of the old electric light company, and which company has just completed a new $40,000 plant, turned the lights on in the city from the new plant. New street lamps have been installed throughout the city, new meters and wires have been placed in the residence and business houses.

BIRMINGHAM, ALA.—The special committee appointed to recommend immediate improvements necessary to the water and light plants in North Birmingham reported that $38,575 is needed to install machinery so that in the event of a break-down on the machinery at the plants at present the city would still be able to furnish water and lights to the people of North Birmingham.

PACHUCA, MEX.—The Compania Negociacion Minera de San Rafael y Anexas, of Pachuca, has installed complete electrical equipment in its mines and mills. It will use about 2,000 horsepower, which it will take from the transmission line of the Mexico Light and Power Company. It is claimed that the company will be enabled to greatly reduce its operating expenses by the use of this electric power. D.

KINGMAN, ARIZ.—The Frisco Mining and Power Company will soon obtain power for the operation of the machinery of its mines and mill in the Union Pass district from a transmission line that is to be extended to that section from the main electric power plant at Kingman. The capacity of this plant is being doubled in order to supply power to a number of mines and industrial concerns in this region. D.

POINTVILLE, KY.—Stuart H. Bowman, together with H. H. Hughes, of the Citizens' Light and Ice Company, has formally assumed the contract for the construction of an electric light plant and water works. The work of construction will begin at once and will go ahead as rapidly as possible. The franchise was secured a few days ago and all details pertaining to the opening up of the work have been arranged.

PARKERSBURG, W. VA.—The plant of the Davis Electrical Company, of Parkersburg, has been taken over by a number of local capitalists, who will make a number of improvements to the plant and continue the manufacture of the medical battery originated by the Davis company. H. F. Behrens has been elected president; George E. Work, secretary; T. R. Cowell, treasurer, and William E. Weiss, general manager.

LAKEVIEW, ORE.—The Southern Oregon Water Power Company, of which Fred H. Oliver is the president, and E. K. Erwin the secretary, has arranged to build a power plant on Deep Creek, three miles from Adel, to generate 10,000 horsepower to be transmitted to Goose Lake, Chewaucan, Warner and Catlow Valleys, and also to this city. Construction work is expected to commence not later than June 1 of next year. A.

TROY, N. Y.—William C. Geer and James A. Burden have signed a lease whereby Mr. Geer secures a right of way for a power plant which he proposes to build on the edge of Burden Pond and to operate under the name of Geer Hydro-Electric Power. Surveys for the proposed plant have been made, and specifications are being drawn up. It is expected that the concrete work will be completed by fall and the plant will be in running order by spring.

MODESTA, CAL.—The Sierra and San Francisco Power Company has secured rights of way from the main power line near Atlanta, south through Ripon, Salida and toward this city. It is the plan of the company to step-down from 100,000 to 15,000 volts and transmit the power southward on a pole line. The line will be built immediately on the securing of the complete right of way. There will be a line from the transformer station westward to the town of Menteca.

CLINTON, ILL.—The Clinton Gas and Electric Company is making many improvements at its electric power plant. Contract has been let for an addition 45 by 72 feet to the engine room. When this is complete the company will install two new Murray Corliss 400-horsepower engines which will be connected to two three-phase sixty-cycle 1,110-volt Westinghouse alternating-current generators with twenty-kilowatt capacity. A new seven-panel switchboard also will be installed. Z.

DECATUR, ILL.—Through an order of Congressman W. B. McKinley, head of the Illinois Traction System and the local street railway lines, decorative lamp standards bearing clusters of tungsten lamps will be placed at the local transfer station. The transfer station, a roomy octagonal Japanese pagoda, is at the convergence of several streets and an excellent effect will be obtained. The

McKinley System already has ornamental clusters at prominent places along its lines. Z.

MOLINE, ILL.—The Moline Retail Merchants' Association voted to have a canvass made of the merchants of the city to ascertain the sentiment of members in regard to installing a boulevard system of lighting to supersede flaming arcs now in use. Z.

GASPORT, IND.—The Gasport Electric Company has been incoporated with a capital stock of $10,000. The object of the corporation is to build and operate a plant to supply the town of Gasport and the inhabitants of Owen County with electricity. Carl Kuffer, Richard Howard, Charles Abraham and Wm. J. Shroder, all of Cincinnati, are directors. S.

GRAND RAPIDS, MICH.—Extensive improvements are contemplated by the Grand Rapids-Muskegon Power Company. Contingent upon the reorganization of the corporation which probably will be effected in ninety days, many miles of wires will be strung within the city and to outside points. Plans are being made for the extension of lines to North Park, Mill Creek, Spring Lake and from the Kent City substation to Casnovia, Sparta and along the lake front at Muskegon. The estimated cost is $200,000.

PALISADE, COLO.—The Mutual Light, Power & Telephone Company has applied for a twenty-year franchise. The company was recently incorporated in Denver with a capital stock of $50,000. It is planned to build a plant at the Farmer's mine, east of town, where cheap fuel can be obtained. An electric light plant and an ice plant, which can also be used for cold storage purposes, will be erected. The company plans to furnish light for the city and also for the ranchers between here and Clifton, including the town of Clifton.

NEW BRAUNFELS, TEX.—The City Council has adopted the report of a minority of the committee that investigated the proposition of building a dam across the Comal River near town and installing a hydroelectric plant. The report was favorable to the project. The waterworks plant will also be equipped with electric pumps. It is claimed that the proposed hydroelectric plant will not only afford a supply of power for the needs of the city, but that it will provide a surplus which may be sold to industrial plants in this section. D.

HOUSTON, TEX.—The work of excavating the ground for the power plant and laboratories of the William M. Rice Institute has been started and will now be pushed. Present plans provide for an expenditure of $65,000 for machinery alone. The equipment will consist of three generating plants, including engines and generators, boilers and compressors and the pumping machinery which will be used to furnish water for the institution. President Lovett is now hopeful that he will be able to announce the opening of the institution Sept. 1, 1911.

STERLING, ILL.—The International Harvester Company is rebuilding the water power from Rock River at its Keystone plant and when completed will install about fifty motors aggregating 500 horsepower. Turbine wheels, seventy-four inches in diameter, will be connected to thirty-kilowatt generators. The electricity furnished will supply about seventy-five per cent of the power needed, were all the machines used continuously, but the percentage of idle apparatus will be above twenty-five per cent so that only in low water and rush seasons will the auxiliary steam plant be needed. Z.

SAGINAW, MICH.—The Saginaw Power Company, the alleged holding company of the Bartlett & Eastern Michigan Power Companies, has secured an injunction preventing the city from interfering with its property. The bill of complaint cites the legality of the Saginaw Power Company and its right to do business in Saginaw, and that the action of the city in declaring the franchise forfeited and ordering the poles and wires removed is a direct violation of the fourteenth amendment of the constitution of the United States. The complaint asks that action of the council be declared unconstitutional and that the injunction be made permanent.

INDIANAPOLIS, IND.—Steps have been taken toward the development of the water power sites on the Tippecanoe River from its mouth near Lafayette to the city of Monticello, a distance of twenty miles. To this end the Washington Hydraulic Company has been incorporated with an initial capital of $25,000. The company proposes to build a series of dams at different points in the river so as to create back water for power to generate electricity for light and power purposes and transmit the same to the towns, cities and country. The directors are: Harry Wade, A. J. Hammond, J. E. Watson and A. E. Wade. The company's headquarters is at 308 K. of P. Building. S.

COEUR D'ALENE, IDAHO.—Following the outcome of the litigation respecting the overflowed lands just below Coeur d'Alene, Idaho, where the Washington Water Power Company has its chief plant, the management is now planning a large power house at Nine Mile Point. Extensive acreage has been bought up recently in the neighborhood so that there will be no likelihood of future damage suits ensuent upon the building of the necessary dam across the river. There is already a plant belonging to the Spokane & Inland Empire system at the same place but the growing demands for power attendant upon the entry of new manufactures into the city, it is anticipated, will presently require an even greater extension of generated power than is at present contemplated.

ELECTRIC RAILWAYS.

(*Special Correspondence.*)

HAGERSTOWN, MD.—Plans are under way for a trolley line which is to run from Hagerstown to Clear Spring and Mercersburg. The route will include many small villages and will extend for about twenty-five miles.

OWOSSO, MICH.—The work of laying the tracks of the Lansing-Owosso electric line has been considerably hindered by the sinking of boggy land. Rails are now laid nearly to Owosso and the track is being ballasted.

OMAHA, NEB.—The Nebraska Transportation Company will construct an electric line from Omaha to Sioux City, 105 miles, and another from Omaha to Norfolk, Neb., 125 miles. Surveys have been finished and right of way secured. Work begins immediately.

MADISON, WIS.—The Madison City Council has granted a franchise to the Chicago & Wisconsin Valley Street Railways Company giving it entrance to this city and the use of certain streets within the city for its interurban lines between Portage and Madison and Janesville. M.

KAUKAUNA, WIS.—The State Railroad Commission has directed the Kaukauna Gas, Electric Light & Power Company to make such repairs as will enable it to furnish adequate service. The company has also been directed to comply with the standards of efficiency as laid down by the commission.

LOGANSPORT, IND.—The new traction company from Logansport to Frankfort, known as the Logansport Southern Traction Company, has filed articles of incorporation with the Secretary of State. The company has a capital of $25,000. The backers, who are all Cleveland, O., men, state that they propose to push the work which was abandoned by Robert Ward and others.

BRAZIL, IND.—Steps have been taken to build an electric traction line from this city to Jasonville. Local and foreign capital will be employed. The line will form a junction with a line to be built from Terre Haute to Clay City and the plan is to secure power from the Indiana Electric Transmission Company, which has just completed a large power house in the coal fields near Terre Haute. S.

RAVENNA, O.—Right of way has been all secured with the exception of a half dozen properties, for the proposed Cleveland, Alliance & Mahoning Valley interurban railway. Building of the line is announced as certain. The complete right of way has been secured in Ravenna, where connections will be made with the Ravenna-Akron line of the Northern Ohio Traction & Light Company for Akron and Cleveland.

ATLANTA, GA.—Judge W. T. Newman, United States District Court, on October 14 issued an order addressed to H. H. Dean, receiver for the railway properties of the North Georgia Electric Company, directing him to purchase certain machinery necessary to the conduct and maintenance of the railway. The amount involved is not specified but the court order shows that S. Fahs Smith of Boston, purchaser of the company at the receiver's sale, has entered no objection to the purchase being made. B.

DEFIANCE, O.—This city is looking forward to three-cent fare street car service. Although the company controlling the street car lines of the city still has a life of eleven years according to its franchise, an ordinance was introduced recently by I. W. Gunderman, a member of the City Council, to revoke the franchise for the reason that the company refuses to sell six tickets for a quarter and thirty for one dollar, as agreed. Gunderman claims to have in view a company which will operate on a three-cent fare basis. H.

SCRANTON, PA.—Plans for the electrification of grades out of Scranton have now received approval by the president and the superintendent of motive power. The proposition will next be submitted to the board of directors and should they also approve, the electrification will take place. The plans call for electric power for moving coal and freight from Scranton to Clark's Summit and Scranton to Lehigh. The change is expected to cut present expenses incident to the using of three and four engines on trains passing over the grades.

AUGUSTA, GA.—At a meeting of board of directors, of the Augusta & Aiken Railway & Electric Company of Augusta, Ga., held in New York, E. G. Tegetoff tendered his resignation as president of the company and allied interests. T. O. Brown of Redmond & Company, was elected to fill his place. This proceeding marked formal transfer of Augusta Street Railway & Lighting Company, and Augusta and Aiken interests from the Harriman Estate to Redmond & Company. B.

HOUSTON, TEX.—The structural steel for the main power house of the Galveston-Houston Interurban Railway will be delivered about November 1. Considerable work has already been done on the plant which is situated on the north bank of Clear Creek. When the main power plant is finished the construction of the two substations will be started. The bridges over Dickinson and Clear Creeks are finished. The entire line will be finished and ready for operation by the time the great re-inforced concrete causeway that is now being constructed across Galveston Bay is completed. D.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

ELKHART LAKE, WIS.—The Wisconsin Telephone Company will extend a line from this point to Franklin.

NASHVILLE, TENN.—The Oliver Springs Telephone Company of Roane County, has been granted a charter.

BILLINGS, MONT.—The Eastern Montana Electric Railway Company will build a line from this point to Bear Creek.

TRENTON, N. J.—The Trenton-Mercer County Traction Company has filed articles of incorporation with a capital stock of $10,000. Peter E. Hurley is named as local agent.

TERRELL, TEX.—Work has begun on the rebuilding of the Texas Midland telegraph lines. S. Binkley with a crew of linemen is in charge of the work.

CHICAGO, ILL.—The National Independent Telephone System has been incorporated by F. H. Woods, E. B. Fisher and H. D. Critchfield. The object is the promotion of business interests.

BOERNE, TEX.—At a meeting of the board of directors of the San Antonio Northwestern Telephone Company, R. L. Blackburn resigned as manager, and the following officers were elected. Charles Reinhard, president; Rud Aue, vice president; George D. Gray, manager, and James O'Connor, secretary and treasurer.

MORTON, IND.—The Morton Telephone Company has incorporated to build, equip and operate a telephone system in Morton and throughout Putnam County. The directors are: N. F. Wood, Russelville, Ind.; J. W. Clodfelter, Russelville, Ind.; Z. B. Burkett, Bainbridge, Ind.; H. W. Sutherlin, Russelville, Ind.; O. M. Thomas, Bainbridge, Ind.; and W. A. Call, Bainbridge, Ind.

ITALY HILL, N. Y.—Articles of incorporation have been filed by the Italy Hill Telephone Company, of Italy Hill, Yates County, N. Y. The company will operate and maintain a telephone line ten miles in length to connect the villages of Italy Hill and Branchport. The capital stock is $1,000 and the directors are: William Emerson, George K. Kenedy, Samuel Wallace and C. E. Campbell, all of Branchport. T.

RENSSELAER, N. Y.—Workmen are engaged in installing a telephone train dispatching service for the Boston & Albany Railroad, between the cities of Rensselaer, N. Y., and Springfield, Mass. This work will be completed by the end of November. The present telegraph service with remain for communication between officials at the different stations and with officers not on the line of the Boston & Albany Railroad.

COXSACKIE FLATS, N. Y.—The Coxsackie Flats Telephone Company has been incorporated with a capital of $3,000 to operate through New York and the eastern states. The directors, all residents of Coxsackie, Greene County, are: Michael Delan, Derrick Sutfin, Fred Hallenbeck, George Van Schaack, Frank Jansen, B. G. Townsend, P. S. Van Schaack.

JACKSONVILLE, ILL.—The stockholders of the Illinois Telephone Company elected the following directors: E. S. Greenleaf, E. P. Kirbey and A. P. Grout. Officers named were: President, E. S. Greenleaf; vice-president, Dr. J. C. Windenham, treasurer, W. W. Ewing; secretary and auditor, R. A. Gates, and general manager Willard W. Holliday. Z.

NEW YORK, N. Y.—Articles of incorporation have been filed by the Electric Service Company to construct and maintain telegraph lines and to lease the same and to install a police signal and fire-alarm service within the borough of Manhattan. The capital stock of the company is $10,000 and the directors are: Robert Leceuver, Richard C. Fitzgerald, James E. Seers, George F. O'Connell, Benjamin F. Tyler, Alice L. Leceuver and Walter J. Rich, all of New York City. T.

MURPHY, N. C.—The Bell Telephone and Telegraph Company has bought out the Cherokee Telephone company of this place. This company had something like 100 miles of poles and wire. This takes in three county seats off the railroad, Blairsville, Union County, Hiawassee, Towns County, Georgia, and Hayesville, Clay County, North Carolina, also Young Harris College, Georgia, and now connects those places with the Bell lines.

PEARSALL, TEX.—B. H. Johnson, acting division superintendent of the San Antonio district of the Southwestern Telephone Company announces that improvements will be made in the plants here and at Cotulla. A new 300-drop switchboard has been ordered installed for the local exchange, and the work of overhauling the entire system and redistributing the cables will be begun shortly. Several new rural lines are also under consideration.

NAPOLEON, O.—The property of the Napoleon Home Telephone Company, of this city, will be sold under an order of the Common Pleas Court. The company went into the hands of Ralph Brown, of Toledo, as receiver, some time ago, following a judgment for $54,684.50 secured by the Cleveland Trust Company, for unpaid interest. All of the company property including franchises in this and several other towns has been appraised but the figures are not given out. The sale will probably occur about December 1. H.

ATTICA, N. Y.—The Telephone Improvement Company has been incorporated with the secretary of state with a capital of $3,000,000 to manufacture and deal in telephone instruments, apparatus and appliances. Of the capital stock, $500,000 is to be seven-per-cent cumulative first preferred; $550,000 seven-per-cent non-cumulative second preferred and $1,950,000 common. The principal office is located in Attica, Wyoming County. The directors are: Chas. H. North, James B. Hoge, Cleveland, O.; Morton E. Lewis, Garrison Babcock, Rochester; Edward E. Clement, Washington, D. C.; Alfred Stromberg, Chicago, and Frederick C. Stevens, Attica.

ELECTRICAL SECURITIES.

Prices during the past week continued to advance and in several cases new records were made. The volume of trading increased approximately thirty per cent over the preceding week, though it was to be noted that steel, with more than 1,100,000 shares dealt in, Reading and Union Pacific made up nearly two-thirds of the entire business.

Standard rails reflected like improvement, New York Central advancing 2 1-12 points on good trading. Local tractions were also strong and the coppers, led by smelters, made substantial gains. The junior steel issues and non-dividend-paying rails were higher. The steel trade reported placing of some sizeable orders for rails and a generally stronger tone, and copper metal was firmer, with large sales.

Directors of the Western Union Telegraph Company have re-elected the officers and executive committee.

After the close of the present fiscal year of the Western Electric Company, which ends November 30 next, the fiscal year will be changed to correspond with the calendar year.

A certificate has been filed by the Edison Storage Battery Company showing that it has issued $1,998,200 additional capital stock. The issue is the outcome of a resolution by the company to increase the capitalization to $3,500,000.

DIVIDENDS.

Cape Breton Electric Company; semiannual $3 a share, on preferred, and an initial $1.50 a share on common, payable November 1 to stock of record October 21.

Commonwealth Edison Company; quarterly dividend of one and one-half per cent, payable November 1.

Pacific Power and Light Company; an initial dividend of one and three-fourths per cent on the preferred stock, payable November 1, to stock of record October 24.

Sierra Pacific Electric Company; regular quarterly $1.50 a share on preferred, payable November 1 to stock of record October 21.

West Penn Railways; quarterly dividend of one and one-quarter per cent, payable November 1.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

NEW YORK.

	Oct. 24.	Oct. 17.
Allis-Chalmers common	10	10
Allis-Chalmers preferred	33½	34½
Amalgamated Copper	71	69⅞
American Tel. & Cable	84	84⅞
American Tel. & Tel.	139½	137
Brooklyn Rapid Transit	78¾	78½
General Electric	154¼	154¾
Interborough-Metropolitan common	22⅝	22⅝
Interborough-Metropolitan preferred	58⅞	59
Kings County Electric	123	123
Mackay Companies (Postal Tel. and Cables) common	93	95
Mackay Companies (Postal Tel. and Cables) preferred	74	75¼
Manhattan Elevated	113½	114¾
Metropolitan Street Railway	*18	*18
New York & New Jersey Telephone	103	103
Pacific Tel. & Tel.	42¼	40¼
U. S. Steel common	79¼	76⅛
U. S. Steel preferred	119⅞	119¾
Western Union	71½	73¾
Westinghouse common	73⅛	72⅝
Westinghouse preferred	120	120

*Last price quoted.

BOSTON.

	Oct. 24.	Oct. 17.
American Tel. & Tel.	139¼	138¾
Edison Elec. Illuminating	264	262
General Electric	154¼	154¾
Massachusetts Electric common	20	20¼
Massachusetts Electric preferred	84½	84½
New England Telephone	135½	133½
Western Tel. & Tel. common	17	17
Western Tel. & Tel. preferred	88	85

PHILADELPHIA.

	Oct. 24.	Oct. 17.
American Railways	43	43
Electric Company of America	11½	11⅝
Electric Storage Battery common	49	50½
Electric Storage Battery preferred	49	50½
Philadelphia Electric	15⅝	15¾
Philadelphia Rapid Transit	18⅝	19
Philadelphia Traction	82	82
Union Traction	42¼	43

CHICAGO.

	Oct. 24.	Oct. 17.
Chicago Railways, Series 1	73	70
Chicago Railways, Series 2	18¾	17½
Chicago Subway	5¼	5¼
Chicago Telephone	120	120
Commonwealth Edison	115	116¾
Metropolitan Elevated common	20	20
Metropolitan Elevated preferred	69	69
National Carbon common	126½	126
National Carbon preferred	119	119

PERSONAL MENTION.

GEORGE B. SPITLER, of Mt. Zion, Ill., was elected treasurer of the Macon County Telephone Company, to succeed P. E. Kuhl, who resigned.

CHARLES H. WALSH, manager of the Burlington, Ia., streetcar and electric lighting company was recently married to Miss Mary Maloney of Chicago.

ALEXANDER GRAHAM BELL was a guest at the first annual dinner of the Victorian Institute of Electrical Engineers, which took place on August 19 last.

MRS. HARRY W. COX, relict of the well-known pioneer in X-ray work, who recently lost his life from injuries resulting from his researches with X-rays, has been awarded a grant of £150 by the British Government.

W. F. CROSSLEY, of Denver, Colo., has been appointed manager of the Central Union Telephone Company's properties in Cairo, Ill., succeeding J. W. Hobbs, who has been transferred to the main office at Springfield, Ill.

C. O. BRANDEL, until recently with the engineering department of the National Electric Lamp Association, has lately become connected with the sales department of the Warren Electric Specialty Company, of Warren, O.

EMANUEL ETIENNE, electrical contractor, of Fort William, Ont., is visiting in Chicago and will be here for the next three or four weeks. Mr. Etienne is considering the advisability of moving his business headquarters to this city.

FRED. M. WELD, master mechanic of the Chicago, South Bend & Northern Indiana Railway Company, of South Bend, Ind., has resigned to take a position with the Birmingham Railway, Light and Power Company at Birmingham, Ala.

P. W. SOTHMAN, chief engineer of the Hydroelectric Power Commission of Ontario, read a paper on October 21 before the Toronto Section of the American Institute of Electrical Engineers, which described the Toronto substation of the Commission.

WILLIAM MARCONI, on the occasion of his recent trip to Buenos Aires, conducted some valuable experimentation on the use of kites in wireless telegraph work. It is reported that "strong" signals were transmitted and received at a radius of 3,500 miles.

GEORGE WESTINGHOUSE was the guest of honor at the ninth annual banquet of the Westinghouse Air Brake Veteran Employees' Association, recently held in Pittsburg, Pa. The date of the banquet was also Mr. Westinghouse's sixty-fourth birthday.

BELA GATI, electrical engineer, of Budapest, and engineer in chief and manager of the Royal Hungarian Telegraph and Telephone Experiment Station in that city, has arrived in New York for a prolonged tour of the United States to study American practice in long-distance telephony, rapid cable telegraphy, and wireless telegraphy. Mr. Gáti is a well-known European expert in these and kindred subjects, and comes here direct from active participation in the second Telegraph and Telephone Conference held in Paris last month.

PROF. M. DE CHATELAIN, of the Institute Polytechnique, Russia, and president of the electrotechnical section of the Russian Imperial Technical Society, has been inspecting the American hydroelectric plants and high-tension lines during the past summer as a representative of the Russian Government. He sailed for Russia on October 18. Prof. Chatelain visited nearly all the important plants in the United States and Canada, and was much gratified by the opportunities extended for their inspection. He was an interested visitor at the New York Electrical Show on its opening day.

LELAND HUME, general manager of the Cumberland Telephone & Telegraph Company, was, on October 17, the guest of honor at a banquet given at Nashville, Tenn., by the officers and heads of departments of the Company. The occasion was in celebration of his twenty-fifth year with the corporation. Mr. Hume started to work for the Cumberland Telephone & Telegraph Company in 1885 in the capacity of clerk. In March, 1886, he was elected treasurer, from which position he was promoted to manager of the Memphis branch. Twenty years ago he was selected as secretary and assistant general manager, later being promoted to the position which he now holds. The watch presented to him at the termination of the recent banquet was a memento of the esteem in which he is held by his many friends.

F. Z. MAGUIRE, of New York, is to be congratulated on his recovery from the long illness which occasioned his temporary withdrawal from business over a year ago. He recently remarked in connection with his return to active work: "I am returning to my work with considerable pleasure and am very glad to be back. I have already opened an office in Baltimore, which has been in contemplation by me for a long time. I will not reopen my Wall Street office for at least a year, although I expect to spend part of my time in New York." Mr. Maguire has been largely interested in the development of numerous electrical and other kindred propositions and has done business for many years in New York and London. About the last piece of business he, with some associates, accomplished before his illness was the successful launching of the Blaugas Company, which is a five-million-dollar corporation, numbering among its directors Comre Benedict, Theodore N. Vail, Theodore Shonts, Judge Gary and a number of other prominent men.

OBITUARY.

EDWARD J. MURPHY, superintendent of the Stock Quotations Telegraph Company, with which he had been connected for twenty-five years, died on October 19, at his home in New York City. Mr. Murphy was forty-nine years of age at the time of his death.

GEN. THOMAS THOMPSON ECKERT, former president of the Western Union Telegraph Company, died on October 20 at his summer home, West End, Long Branch, N. J. He was in good health up to a few weeks before his death, having entirely recovered from his recent illness. General Eckert was born in St. Clairsville, O., eighty-five years ago, and spent his boyhood on his father's farm. Catching the enthusiasm of the telegraph, he went to Wheeling, W. Va., against the wishes of his parents, to enter a newly-opened telegraph office there. Failing in this he went to New York, after many difficulties, and learned telegraphy in the office of Morse's telegraph company in the Astor House. After the problems of the telegraph had been mastered Eckert returned to Ohio, where he supervised the Fort Wayne railroad extension, then the new extension of the Western Union line. In 1859 his restless nature led him to seek new adventures in the supposed gold fields of North Carolina. Driven back from there to the North by the breaking out of the Civil War, he was placed in charge of the military telegraph lines. Later he was chosen Assistant Secretary of War and was also made Brigadier General. It is said that he enjoyed the confidence of President Lincoln and Secretary Stanton to a greater extent than any other person at that time in the service. General Eckert returned to the Western Union company at the period of its greatest expansion, when it was absorbing companies which had formerly been keen rivals. In the early part of 1870, in the position of general superintendent of the company, his strong personality and diplomacy were shown by the manner in which he handled the strike of the Telegraphers' Protective League. During the fight between the Western Union and the Atlantic & Pacific companies, he was elected president of the latter, and was in 1893 made president of the Western Union. General Eckert was buried at New York in the $80,000 vault which he built under old St. Patrick's Cathedral at Mulberry and Mott streets. The honorary pallbearers were Andrew Carnegie, R. M. Galloway, Thomas H. Hubbard, Edward Murphy, Jr., Dr. John B. McMahon, Albert B. Chandler, David Homer Bates, Charles A. Tinker, James Merrihew, P. J. Casey and William S. Hawk. General Eckert is survived by two sons, Clendenin and Thomas Thompson, Jr.

LEGAL NOTES.

TELEPHONE COMPANY A PUBLIC SERVANT.—A telephone company in devoting its property to a use in which the public has an interest becomes a public servant, and is bound to serve the public impartially. It is like common carriers in that it is bound to serve those applying to it impartially and upon equal terms. A telephone company, being a public servant, cannot refuse to serve any one of the public in that capacity in which it has undertaken to serve the public when such one offers to pay its rates and comply with its reasonable rules and regulations. It cannot refuse to serve him until he pays a debt contracted for services rendered in the past. For the present service it has a right to demand no more than the rate of charge fixed for such services. Should a telephone company incur a penalty by refusing to rent or render service, it can prevent the increase thereof by renting or offering to rent the telephone, or rendering, or offering to render, the service.—Supreme court of Arkansas in Danaher vs. Southwestern Telegraph & Telephone Co., 127 S. W. 963.

SEPARATE FRANCHISE NECESSARY FOR SURFACE LINES.—The Court of Appeals of New York, in a decision handed down recently in the action of the Long Island Railroad Company against the city of New York, held in substance that the company may not use the same franchise for maintaining a surface line when operating both an elevated and underground railway. The railroad claimed title to a thirty-foot strip of land on Atlantic Avenue in the borough of Brooklyn, in which its railroad is now operated partly in depressed tunnels and elevated structures. By right of such alleged ownership the company laid its tracks upon the surface of the strip, over the depressed tunnels and under the elevated structures at great expense. The city threatened to remove the surface tracks as an unlawful obstruction of the highway and the company procured an injunction restraining any interference with its line. The city demurred to the complaint on the ground that it did not state facts sufficient to constitute a cause of action, and its contention was upheld in the lower courts and now in the highest court in the state. In 1885 an agreement was made by which the railroads agreed to convey the strip of land in question to the city of Brooklyn and receive an easement to use and occupy the strip. It was claimed by the city that the company was already occupying the land for the purpose of operating a railroad under its franchise and that its attempted use of the surface of the street was unlawful as an exercise without authority and an interference with the public use of the street.

POINTS WITH REFERENCE TO PAYMENT AND COLLECTION OF TELEPHONE BILLS.—If a subscriber paid for the month of March, the court of civil appeals of Texas says that the contract was renewed for that month, and, if he tendered the $2 for April when it became due, and the $2 for May, when it became due, the company had no right to refuse him service for those months because he owed for the month of February. The contract gave it no such right ,and, if it did, the court does not think a public service corporation of this kind could refuse to furnish service to any one who offered to pay the legal or customary charge for such service on the ground that such person owed the corporation for past services which he had refused or failed to pay. But an offer to pay the lineman was ineffectual as a tender of the amount due for May, as the lineman was not authorized to receive the money for the company, and therefore a tender to him was not a tender to the company. The company was not required by its contract to send to the subscriber's place of business to collect the amount due by him, but, if it agreed to send there for the money, it waived the right to require payment at its office, and, if he left the money for the May rent at that place under such agreement with the company, that was a sufficient compliance with his contract to entitled him to telephone service for that month. There was evidence to the effect that the company had at times sent collectors to the places of business of the users of its telephones for the purpose of collecting the telephone rent, but the evidence was not sufficient to establish a custom of that kind binding upon the company.—Southwestern Telegraph & Telephone Co. vs. Luckett, 127 S. W. 856.

NEW PUBLICATIONS.

PENNSYLVANIA ENGINEERING BULLETIN.—The Engineering Experiment Station of the Pennsylvania State College has begun the publication of a bulletin, the first number of which has appeared under date of June 1, 1910. It contains "Purpose and Work of the Engineering Experiment Station," "The Effects of Wave Form on Incandescent Lamps," by C. L. Kinsloe, and "Practical Suggestions for the Construction of Concrete Floors," by E. D. Walker.

HIGH EFFICIENCY LAMPS.—The National Electric Lamp Association has published in bulletin form a paper entitled "High Efficiency Lamps—The Effect on the Cost of Light at the Central Station," which was read by S. E. Doane, chief engineer of the engineering department of the National Electric Lamp Association before the National Electric Light Association at its thirty-third convention in St. Louis, Mo., May, 1910. This paper gives a critica analysis of the effect of high-efficiency lamps on the cost of light and gives a description of a method of charging based upon some very radical and logical assumptions. In addition to the reprint of the paper there are several editorials which have been taken from the leading technical papers.

TWO NEW NATIONAL ELECTRIC LAMP ASSOCIATION BULLETINS. The Engineering Department of the National Electric Lamp Association has just issued two Bulletins; one entitled "Mazda Multiple Lamps" (Bulletin 13) and the other "Hylo-Economical Turn-Down Electric Lamps" (Bulletin 14). Bulletin 13 contains practical information and technical data on Mazda Multiple Lamps for use on 100-125 volts and 200-250 volts. It has three tables and fourteen cuts. Besides listing and illustrating a number of the lamps considerable data are given on the operation, performance and characteristics of Mazda multiple lamps. Bulletin 14 describes that unique electric lighting device, the turn-down lamp. The principle on which these lamps operate is fully explained and illustrated by means of diagrams. The Bulletin contains one table and twelve cuts. Either or both of the above bulletins will be furnished gratis to parties requesting them by the Engineering Department of the National Electric Lamp Association, 4411 Hough Avenue, Cleveland, O.

PROPOSALS.

TROLLEY SYSTEM, INVERCARGILL, N. Z.—Tenders are asked for the manufacture, supply and delivery of a complete electric trolley system for the above town. Contracts will be divided into a number of sections as are indicated in the advertising pages of this issue. Specifications may be seen at the offices of R. W. Hunt & Company, 1121 Rookery Building, Chicago, and R. W. Cameron & Company, No. 23 South William Street, New York City.

POST OFFICE, LEWISTON, IDAHO.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until November 22 for the construction complete (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the United States Post Office at Lewiston, Idaho, in accordance with drawings and specification, copies of which may be obtained from the custodian of site at Lewiston, Idaho, or at the Supervising Architect's office.

POST OFFICE, EAGLE PASS, TEX.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until November 19 for the construction, (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the United States post office and custom house at Eagle Pass, Tex., in accordance with drawings and specifications, copies of which may be had at the office of the Custodian of the site at Eagle Pass, or at the Supervising Architect's office.

INDUSTRIAL ITEMS.

W. N. MATTHEWS & BROTHER, St. Louis, Mo., are mailing slips advertising Matthews' guy anchors, cable rollers, bridle rings, and the new 567 wrench. The latter is for use with Matthews guy anchors. A folder enclosed with the slips illustrates the Matthews two-bolt guy clamp. This clamp is so arranged as to prevent slipping of the guy wire, and is very easily attached.

THE D. & W. FUSE COMPANY, Providence, R. I., has put upon the market a new magnetic chuck for use with direct current only. The coils are wound with "Deltabeston" wire, which will withstand prolonged overheating and can be made up in any number of units. The chuck was shown for the first time at the recent convention of the American Street & Interurban Railway Association at Atlantic City.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., recently issued to the trade copies of Bulletin No. 126 and No. 127. The first describes an oil insulator devised for the insulation of batteries. Bulletin No. 127 gives a description of the automatic regulating apparatus designed and manufactured by the Company. A wiring diagram, illustrations of the apparatus and curves taken with and without the average adjusters are shown. The automatic current stop is also shown.

PARTRICK, CARTER & WILKINS COMPANY, Philadelphia, Pa., has distributed catalog No. 25, dealing with its line of electrical house goods and supplies. The company furnishes annunciator and alarm systems for cash calls, salesman calls, and other uses. These will be made to fit any special cases, and the company solicits information regarding systems of this kind which are contemplated. Especial attention is called in the catalog to the patent needle annunciator, which has already found a very wide use.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, Pittsburg, Pa., has recently received an order from the Public Service Electric Company for two 5,000-kilovolt-ampere, 13,200-volt, three-phase, sixty-cycle, 1,800 revolutions-per-minute turbo-generators. These will be installed in the new power house of the Public Service Company at Perth Amboy, N. J. The Westinghouse Company has also entered the order of the Utica Gas & Electric Company, of Utica, N. Y., for two 1,000-kilovolt-ampere, self-cooled tubular type transformers.

THE IDEAL ELECTRIC & MANUFACTURING COMPANY, of Mansfield, O., announces that the Machinery & Supply Company, of No. 61 Fremont Street, San Francisco, Cal., has been appointed its Western Agent. The Machinery & Supply Company now carries a full line of "Ideal" apparatus covering the principal sizes. This line includes alternating and direct-current generators, induction motors, both of the slip-ring and squirrel-cage types, special direct-current and alternating-current elevator motors and also a complete line of direct-current motors.

THE WESCO SUPPLY COMPANY, St. Louis, Mo., announces that its new general supply catalog No. 150 is being distributed to the trade. The book contains 1,400 pages, covers every department, including general supplies, electrical novelties, street railway material, etc., and is one of the most complete catalogs of electrical supplies issued. The company also announces that it is erecting a new building on the corner of Eighth Street and Clark Avenue, St. Louis, Mo. The building will be an exact duplicate of the present one at Seventh Street and Clark Avenue.

THE BRISTOL COMPANY, Waterbury, Conn., recently published an illustrated index of the Bristol recording instruments for pressure, temperature and electricity. The booklet is not intended as a catalog, but is simply a series of illustrations of the most important Bristol instruments with partial explanation of each instrument and its applications. A brief history of the company is included, mention being made of the first recording instruments, put out in 1889, and the various steps in the development being traced. Throughout the booklet the illustrations are excellent, the fine grade of paper used adding much to their attractiveness.

MASCHINENFABRIK OERLIKON, Zurich, Switzerland, has issued a number of pamphlets describing hydroelectric generating stations at Schaffhausen and Cervara, and the transmission lines connecting the latter with Narni and distributing power through the Canton of Schaffhausen. They have also issued a number of circulars dealing with transformer towers, oil-immersed transformers, railway controllers, railway motors, motors with vertical shafts, waterproof three-phase motors, and electric melting furnaces. Bulletins Nos. 60 to 63 give figures of performance for the Freiburg-Murten-Ins and the Sernftal railways, and descriptions of motors for spinning machinery, regulators for induction motors, and alternating-current locomotives.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., announces that several new contracts for apparatus have been secured. Among these is a seven-panel switchboard for the Indiana Steel Company, at Gary, Ind. The entire controlling equipment will also be supplied by the General Electric Company. The Company is also supplying sixteen series mercury-arc rectifier outfits to the Union Light & Power Company, of St. Louis. These are in addition to a set of eight which were installed about a year ago. The Long Beach, Cal., station of the Southern California Edison

Company has ordered of the company a large switchboard to control one 15,000-kilovolt-ampere 11,000-volt turbo-generator; three 2,000 kilowatt, 11,000-volt local feeders; two 11,000-35,000 to 70,000, 6,000-kilowatt stepup transformers and two 70,000-volt outgoing lines.

THE WESTERN ELECTRIC COMPANY has issued Bulletin No. 1020 describing magneto multiple switchboards of the No. 1800 sectional type. The flexibility of operation and ease of increase in size of these switchboards make them especially adaptable for small but rapidly growing telephone systems. The bulletin, which is illustrated with many photographs, contains a detailed description of the line circuit apparatus, paying attention both to combined jacks and signals and the line drops. A list of the apparatus required, with different varieties of cord circuits, is given, and other sections are devoted to a description of the operator's telephone circuit and its apparatus, the ringing and night alarm circuits and apparatus, wiring and cabling and line terminal arrangement. The switchboard units are described, as well as methods of assembling these units.

THE WAVERLEY COMPANY, Indianapolis, Ind., has issued its 1911 catalog, which is unusually handsome and artistic. The catalog is 9 by 14 inches in size, printed on heavy enamel paper and bound in imported hand-made cover stock of a rich mottled brown. On the second cover page is mounted a photogravure representing a Waverley open carriage driven by a winsome little girl of four in one of the most beautiful parks of Los Angeles, the brown tones of the photogravure on Japanese vellum harmonizing with the cover stock. The illustrations include thirteen full page half tones representing Waverley 1911 Models, with backgrounds illustrating prominent buildings and park scenes in the leading American cities. These backgrounds have been ruled down by a new process of half-tone work in such a manner that the cars stand out with unusual prominence and give the effect of two separate printings in gray and black. In addition to these thirteen pages there is a high-light half-tone on page nineteen, a ghost picture on page twenty-one. There are also two-toned half-tones, each of which is a successful handling of a difficult problem. The composition and press work are as praiseworthy as the illustrations, while the initials and printer's ornaments, though sparingly used, add much to the artistic effect of the whole.

DATES AHEAD.

American Association of Electric Motor Manufacturers. Semi-annual meeting, Chicago, November 14-16.

Alabama Light and Traction Association. Annual meeting. Anniston, Ala., November 21-23.

American Physical Society. Annual meeting, Chicago, Ill., November 25 and 26.

American Association for the Advancement of Science, and affiliated societies. Minneapolis, Minn., December 27-31.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) October 18, 1910.

972,798. SPARK-PLUG. George Baehr, McKeesport, Pa. Filed Aug. 24, 1909. A spark device for gas-engine cylinders including inner and outer heads provided with aligned openings has a fixed electrode carried by the inner head, a movable electrode working in the opening in the inner head, a solenoid carried by the outer head and lying at the outer side thereof, and means co-operating with the solenoid and the movable electrode for actuating the latter and passing through the opening in the outer head.

972,799. BRUSH-HOLDER FOR DYNAMO-ELECTRIC MACHINES. Herbert A. Balcome, Jamaica Plains, Mass., assignor to B. F. Sturtevant Company, Boston, Mass. Filed March 19, 1902. The brush holder comprises a stationary member, a movable member mounted to slide thereon provided with an open-sided socket to receive a brush of greater width than the stationary or movable member, means for frictionally clamping the brush in the socket and a feed screw bearing against the end of the brush.

972,811. CIGAR-LIGHTER. John W. Burnett, Cambridge, Mass., assignor of one-half to William K. Mason, Cambridge, Mass. Filed April 13, 1910. There is a time device included for automatically breaking the circuit after a predetermined time.

972,814. ELECTRICAL RELAY. John F. Cadell, Baltimore, Md., assignor to The North Electric Company, Cleveland, Ohio. Filed Oct. 29, 1907. An electrical relay comprises an electromagnet provided with a central core, an L-shaped return bar having an opening secured to the core at one end of the magnet and having one arm extending above the latter, a pivoted armature secured on the return bar at the other end of the magnet, parallel rows of contact-springs carried by the return bar and a pressure bar loosely carried on the armature and having a reduced portion adapted to pass through the opening and to engage one of the rows and contacts to force the latter into contact with another row.

972,838. ELECTRIC WELDING-MACHINE. Sebastian Ziani de Ferranti, Grindleford Bridge, near Sheffield, England. Original application filed Dec. 15, 1905. Divided and this application filed Feb. 18, 1907. A machine for attaching turbine blades to a carrying element.

972,839. TELEPHONE ATTACHMENT. Willard C. Fisk and Harry L. White, Orofino, Idaho. Filed April 14, 1910. The attachment consists of an interrupting device connected with the telephone circuit, means connecting the device to the telephone receiver hook, and means to prevent the telephone circuit from being opened until the interrupting device has operated.

972,840. FIRE-ALARM. John E. W. Fogal, Arthur M. Crichton, and Archie C. Mowry, Quincy, Ill., assignors to Quincy Elevator Gate Company, Quincy, Ill. Filed Feb. 18, 1909. A electric signal system.

972,845. SAFETY-BRAKE AND LOCK-SWITCH MECHANISM FOR ELECTRIC AUTOMOBILES. Oliver P. Fritchle, Denver, Colo., assignor to The Fritchle Automobile and Battery Company, Denver, Colo. Filed Dec. 27, 1909. A safety device for electric automobiles comprises a switch arm, a spring-pressed hook engaging the arm, a controller mechanism having a handle and connections therefor to disengage the hook when the controller is in off position, a brake-setting device, an operating rod therefor, and an arm connected to this rod to operate the switch arm to open the switch.

972,850. ROTARY FIELD MEMBER OF DYNAMO-ELECTRIC MACHINES. Alexander M. Gray, Milwaukee, Wis., assignor to Allis-Chalmers Company. Filed May 13, 1909. The construction permits of forced air ventilation of the rotor.

972,874. SELF-ACTING TELEPHONIC LINE-CONNECTING SYSTEM. Bernhard Kugelmann, Bad Kissengen, Germany. Filed June 12, 1907. For each group of subscribers' lines there are a number of preselectors, each comprising a traveling contact device and arranged to engage with a subscriber's line.

972,877. ELECTRIC-SIGN LETTER. Frederick Hurst Lansdell, Atlanta, Ga. Filed Nov. 20, 1909. A sign character comprises a support, a hollow character mounted thereon and having its face provided with openings and closely arranged apertures between adjacent openings, and lamps secured in the character with portions protruding out of the openings, the openings being larger in diameter than the protruding portions of the lamps to leave annular spaces around the lamps.

972,892. RECTIFIER. William Meyer, Chicago, Ill. Filed March 30, 1908. A chemical rectifier is interposed in an alternating current circuit for transforming the alternating current into a direct current, means are interposed in the alternating-current circuit for causing the current curve to approach the true sine curve; and an asymmetric cell is shunted across the conductors of the direct-current circuit of the rectifier, the last-mentioned cell having an aluminum anode.

972,893. MANUFACTURE OF FILAMENTS FOR ILLUMINATING AND HEATING PURPOSES. Georges Michaud and Eugène Delasson, Montreuil, Seine, France. Filed May 6, 1908. The process of manufacturing incandescing filaments consists in agglomerating material, forming the same into a filament, subjecting the filament to the action of a gaseous flame whereby an initial fusion is produced, and afterward subjecting the filament to the heat from an electric arc.

972,929. DYNAMO-ELECTRIC MACHINE. Charles E. Search, Milwaukee, Wis., assignor to Allis-Chalmers Company. Filed March 27, 1909. An inclosing housing comprises a yoke or main portion and an end cover, and means carried by the end cover securing the latter to the yoke, the end cover being adapted to be turned through any angle with respect to the yoke and having a manhole through which access may be had to different parts of the interior of the housing.

972,947. ELECTROLYTIC DECOMPOSITION OF SOLUTIONS. Clinton P. Townsend, Washington, D. C., assignor to The Development and Funding Company, New York, N. Y. Filed April 12, 1902. Renewed March 9, 1909. The process of electrolyzing solutions consists in passing an electric current through the solution and a diaphragm to an electrode and recovering a product of electrolysis by means of a non-saponifying oil.

972,950. COIL. Anton Voegtle, Harry C. Lea, and Richard H. Voegtle, Sharpsburg, Pa. Filed June 17, 1909. An induction coil.

972,956. TERMINAL-PLUG RECEPTACLE. John E. Ward, New York, N. Y., assignor to Ward Equipment Company, New York,

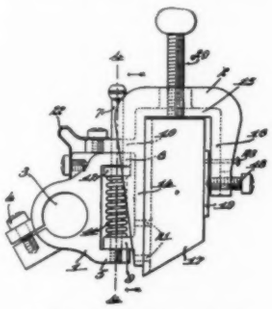
N. Y. Filed July 9, 1909. A terminal plug receptacle for railway cars comprises a bracket, a casing pivoted to the bracket so as to swing horizontally when in position on the car, electrodes, and a frame within the casing to support the electrodes.

972,962. SERVICE-METER SYSTEM. Alfred H. Weiss, Chicago, Ill., assignor to Kellogg Switchboard & Supply Company, Chicago, Ill. Filed Nov. 29, 1907. A telephone meter.

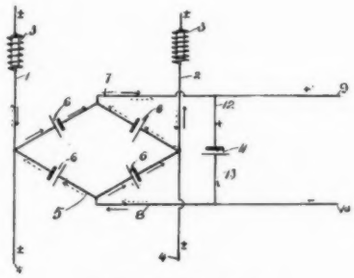
972,963. ELECTRICAL FUSE. Allen West, Westminster, London, England. Filed Dec. 4, 1909. A fuse carrier is formed with side lugs at the top and bottom from insulating material all in one piece, and having a contact cheek or cheeks disposed within the lugs, and with a spring adapted to press same outward and means for limiting their outward travel.

972,964. THERMIC CIRCUIT-CLOSER FOR ELECTROMAGNETIC APPARATUS. Garrett White, Chapel Hill, Tenn., assignor of one-half to William B. Neely, Chapel Hill, Tenn. Filed Sept. 2, 1909. A thermic circuit closer for an electric circuit has an open-topped glass tube constructed with a mercury-chamber expansion near its lower end, a lining of a material absorbent of dampness and nonabsorbent to mercury within the main body of the tube including its upper end, a lower contact wire sealed within the lower end of the tube, and an endwise movable needle extending into the upper end of the lined tube, the expansion and the lower end of the lined portion of the tube being occupied by mercury.

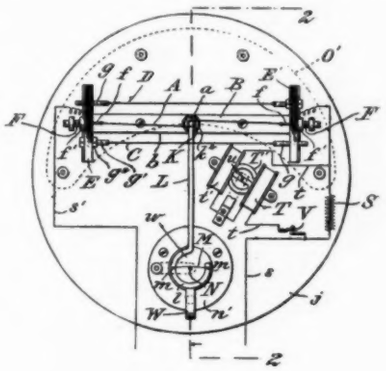
972,986. PLURAL LAMP-SOCKET. Reuben B. Benjamin, Chicago, Ill., assignor to Benjamin Electric Manufacturing Company, Chicago, Ill. Filed March 27, 1907. The socket includes a baseplate, a cover carried by this plate, lamp-receiving sockets extending through the cover and sustained thereby, contact-plates within the cover and sustained by the lamp-receiving sockets, and lamp-terminal-engaging means associated with each of the sockets and electrically connected with the contact-plates.



912,799.—BRUSH HOLDER.



972,892.—RECTIFIER.



973,152.—METER.

972,987. PLURAL LAMP-SOCKET. Reuben B. Benjamin, Chicago, Ill., assignor to Benjamin Electric Manufacturing Company, Chicago, Ill. Filed April 11, 1907. Similar to the preceding.

972,988. INDICATING MEANS FOR PARTY-LINE TELEPHONES. James H. Blythe, Denver, Colo. Filed June 24, 1907. A device for indicating the condition of party-line telephones consists of an indicating member, a disk having a recess on the periphery of its inner face for actuating the indicating member, and suitable means for actuating the disk.

972,994. INSULATOR. John H. Campbell, Ripley, O. Filed November 23, 1904. Renewed February 25, 1910. The insulator comprises a head portion to which the wire is attached, a pin (forming means of attachment to a support), a groove in the lower part of the head, and a bead on the cross arm, over which the head fits.

972,999. ELECTRIC REVERSING-SWITCH. John F. Cavanagh, Providence, R. I., assignor of three-fourths to Lindsley and Allen Electric Company, Providence, R. I. Filed November 5, 1908. The switch comprises a circuit having contact terminals, an arm mounted to swing between the terminals and provided with contacts, and means for automatically shifting the contacts each time the arm is swung, whereby the current is reversed through the circuit.

973,000. RESISTANCE-GRID. Herbert W. Cheney, Milwaukee, Wis., assignor to Allis-Chalmers Company. Filed December 26, 1908. A resistance-grid comprises a conductor having end turns out of alinement, and an insulated reinforcing bar located between these turns.

973,014. ELECTRIC-LAMP FIXTURE. Perry E. Doolittle, Toronto, Ontario, Canada, assignor to Doolittle Rim Company, Ltd. Filed December 21, 1908. An electric-lamp-adjusting fixture has a rotatable drum, a coiled winding spring therefor, a pendent lamp-carrying cord passing over the drum and carried by and following the convolutions of the spring, and means to hold the drum inoperative.

973,030. AUTOMATIC GAS-IGNITER AND SAFETY DEVICE. Eugene E. Gerald, Baltimore, Md. Filed January 22, 1910. An electric circuit is closed by the opening of the valve.

973,037. ROTOR FOR HIGH-FREQUENCY ALTERNATING-CURRENT MACHINES. Albert E. Guy, Trenton, N. J., assignor to De Laval Steam Turbine Company, New York, N. Y. Filed April 10, 1909. An inductor rotor comprises a disk having projecting teeth of magnetic material, certain of such teeth having projections bridging the spaces between the teeth, and filling pieces between the teeth and held therein by the projections.

973,050. LAMP. Gottlieb Keller, New York, N. Y. Filed June 12, 1907. Renewed February 18, 1910. A lamp comprises a globe having its open neck provided with a threaded collar, a threaded sleeve screwing in the collar and having an outwardly extending flange, an electric lamp within the globe and having its socket extending through the sleeve, a reflector surrounding the globe and on which the flange is seated, and a clamp engaging the deflector and the socket to support the reflector from the socket.

973,089. ELECTRIC HEATER. Henry C. Walter, Wilkinsburg, Pa. Filed October 11, 1909. An electric heater for car windows and the like has a body part comprising a sheet of mica and a connected resistance coil, and means for attaching the heater to the window, whereby it will lie against the usual pane thereof.

973,096. PLUG-SWITCH. Frederick B. Adam, St. Louis, Mo., assignor to Frank Adam Electric Company, St. Louis, Mo. Filed December 20, 1909. A plug switch has a contact that comprises a part to which the conductor is connected, and a plurality of movable wings or arms connected to this part and having their free ends lapping over each other, the wings being provided with bent portions that co-operate with each other to form a split sleeve which completely surrounds the plug of the switch.

973,152. ELECTRICAL MEASURING INSTRUMENT. Maurice J. Wohl, New York, and Harry Hertzberg, Brooklyn, N. Y., assignors to Abbot A. Low, Horseshoe, N. Y., Maurice J. Wohl, New York, and Harry Hertzberg, Brooklyn, N. Y., trustees. Filed November 26, 1907. A current-carrying member is provided with an offset, and an automatic slack take-up comprises a torsion spring co-operating with this member and supporting it mechanically from sagging.

973,154. SIGNAL SYSTEM. Robert S. Woods, Los Angeles, Cal. Filed July 19, 1909. An electric alarm system.

973,157. INCANDESCENT LAMP. Delo Hoke Bering, Pittsburg, Pa. Filed November 13, 1909. A multiple-filament lamp with special filament-feeder system.

973,171. PROCESS OF TREATING BARIUM CHLORIDE AND STRONTIUM CHLORIDE FOR PRODUCING CHLORINE AND HYDROXIDE OF THE SAID METALS. Adolf Clemm, Mannheim, Germany. Filed March 11, 1910. The process of treating an alkaline earth metal chloride for producing chlorine and the corresponding hydroxide by electrolysis, comprises subjecting the solution of such chloride to a partial electrolysis until the solution of the chloride is nearly saturated with the corresponding hydroxide, withdrawing the solution, and cooling the withdrawn solution and thereby crystallizing the hydroxide.

973,198. TELEPHONE-RECEIVER HOLDER. John F. Hines, Pittsburg, Pa. Filed November 18, 1909. A device clamping to telephone pedestal.

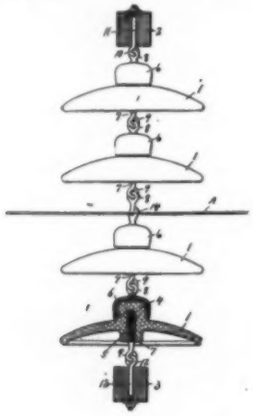
973,199. CLUSTER-SOCKET. Delos Holden, Upper Montclair, N. J., assignor to John H. Dale, New York, N. Y. Filed March 16, 1908. Comprises a rigid metallic ring, and a plurality of insulating blocks, threaded shells and center contacts carried thereby, the center contact for each shell being in electrical connection with the ring.

973,204. INSULATING SYSTEM FOR HIGH-POTENTIAL ELECTRIC CONDUCTORS. Fred M. Locke, Victor, N. Y., assignor to the Locke Insulator Manufacturing Company, Victor, N. Y. Filed August 27, 1908. A system of insulation for high-potential electric conductors comprises a series of insulators arranged in superposed sequence some distance apart, supports at opposite ends of the series, connections between the supports and adjacent insulators whereby the insulators may turn with respect to the supports, separate connections between adjacent ends of the insulators whereby each insulator is free to turn, and a seat for a conductor on one of the last-named connections and between the supports.

973,216. ELECTROMECHANICAL DEVICE. George H. Rowe, Berwyn, Ill., assignor to Electro-Magnetic Tool Company, Chicago, Ill. Filed October 17, 1908. The device comprises a coil, an iron yoke surrounding the coil, a field core slidable within the coil and in contact with parts of the iron yoke, an armature within the field core, and means for reciprocating the field core.

973,235. ILLUMINATING DEVICE AND REFLECTOR. Joseph Taussig, Chicago, Ill. Filed November 6, 1909. An illuminator and reflector for show cases.

973,250. ELECTRIC FUSE. Irvin E. Barrickiow, Antioch, Cal. Filed February 10, 1910. The fuse includes a casing provided



973,204.—INSULATOR.

with an opening, a cover for the opening, a fusible element in the casing, and a tubular retainer for the cover removable from the casing.

973,257. INDICATING-SWITCH. Ralph C. Browne, Salem, Mass., assignor to Browne Apparatus Company, Salem, Mass. Filed November 19, 1906. An indicating snap switch comprises a rotary arbor, terminals, a sonorous body, and means carried by the arbor to both connect the terminals and cause the sonorous body to emit an audible signal.

973,322. THROW-OUT SWITCH. Wilson H. Tucker and William F. Waddell, New York, N. Y. Filed March 10, 1909. An automatic electric cut-out switch.

973,334. INDICATOR FOR CARS. William D. Baldwin, New York, and August Sundh, Yonkers, N. Y. Filed January 16, 1905. In combination with a plurality of cars are: an indicator for each car, electromechanical devices for actuating such indicators in one direction, additional electromechanical devices for actuating the indicators in the reverse direction, an electric circuit in which the devices are included, a reversing switch on each car, and an automatic circuit-closer for each car.

973,335. AUTOMATIC STOP MECHANISM. Charles S. Batdorf, Brooklyn, N. Y., assignor to Automatic Coin-Wrapping Machine Company, New York, N. Y. Filed October 19, 1908. An automatic stop mechanism for electric power-driven machines comprises a power circuit and electrical connections controlling the power circuit, the connections being so arranged adjacent to the machine that displacement of an article or articles of conductive character being operated upon thereby and the lodging thereof across the connections will serve to close the connections and open the power circuit.

973,340. RINGING-MACHINE. James E. Burge, Lincoln, Neb. Filed December 6, 1907. A frame structure for pole changers.

973,362. ELECTRIC SWITCH. Ernest K. Mackintosh and Ezekiel A. Smith, Washington, D. C. Filed December 16, 1909. A float-controlled switch.

973,409. INSULATED HANGER. Edward Crabbe, Seattle, Wash. Filed February 19, 1910. A hanger or support for electric wires comprises a block having a circumferential groove, a yoke projecting from the block and spanning the groove, and a support having an involute spiral with which the yoke is designed to engage.

973,447. TIMER AND DISTRIBUTER. Thomas H. McQuown, Cambridge, Mass., assignor to Monitor Manufacturing Company, Boston, Mass. Filed June 21, 1907. An electric circuit-breaker.

973,464. SPARK-PLUG. Vincent C. de Ybarrondo, Los Angeles, Cal. Original application filed May 20, 1907. Divided and this application filed February 27, 1908. Includes a renewable terminal.

REISSUE.

13,158. ELECTRIC LAMP. David D. Lockwood, Bridgeport, Conn. Filed August 17, 1910. Original No. 932,621, dated August 31, 1909. An electric lamp includes a reflector, supporting means for the reflector, a shade movably supported from the reflector, and means for holding the shade in adjusted position, this means consisting of a pintle, a head which receives the pintle and a setscrew.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the United States Patent Office) that expired October 24, 1910:

507,125. ELECTRIC SIGNAL FOR RAILWAYS. Albert B. Herrick, Bayonne, N. J.

507,139. STORAGE BATTERY. Charles W. Kennedy, Philadelphia, Pa.

507,144. APPARATUS FOR CONTROLLING THE APPLICATION OF ELECTRICAL CURRENTS. Robert Lundell, Brooklyn, N. Y.

507,147. DEVICE FOR SELECTING AND OPERATING MECHANICAL APPARATUS. Robb Mackie, Cincinnati, O.

507,148. APPARATUS FOR SELECTING AND OPERATING MECHANICAL DEVICES. Robb Mackie, Cincinnati, O.

507,150. CUT-OUT. Louis W. Miller, Rochester, N. Y.

507,170. ELECTRIC ALARM-SIGNAL FOR RAILWAY TRAINS. James M. Rupel, Kansas City, Kan.

507,194. ARMATURE FOR DYNAMOS. James J. Wood, Fort Wayne, Ind.

507,205 and 507,206. ELECTRIC SELECTING DEVICE. Samuel S. Bogart, New York, N. Y.

507,217. ELECTRIC HEATER. Charles L. Coombs, Washington, D. C.

507,247. TROLLEY-WIRE CLEANER. Charles H. Thompson, Detroit, Mich.

507,257. INSULATED WIRE. Herman H. Brown, Montreal, Can.

507,269. ELECTRIC DOOR-OPERATING APPARATUS. Oliver H. Hicks and Robertus F. Troy, Chicago, Ill.

507,297. ARMATURE-COIL FOR DYNAMOS. Gilbert Wilkes, Detroit, Mich.

507,298. APPLICATION OF ELECTRICITY TO PIANOS OR OTHER KEYED INSTRUMENTS FOR HYGIENIC PURPOSES. William Willeringhaus, London, England.

507,322. ELECTRIC FIRE AND STABLE ALARM AND HORSE-RELEASER. Alexander R. Holmes, New York, N. Y.

507,339. CLOSED-CONDUIT ELECTRIC RAILWAY. Robert Weir, Montclair, N. J.

507,343. HANGER-BOARD FOR ELECTRIC ARC-LAMPS. James J. Wood, Fort Wayne, Ind.

507,345. RESISTANCE-COIL. James J. Wood, Fort Wayne, Ind.

507,364. HANGER FOR ELECTRIC LAMPS. Giles P. Hiler, Grand Haven, Mich.

507,391. SYSTEM OF ELECTRICAL DISTRIBUTION. William Stanley, Jr., and John F. Kelly, Pittsfield, Mass.

507,396. ELECTRIC LOCOMOTIVE. James T. Wilson, Tyrone, Pa.

507,403. CONNECTOR. Charles Bell, Stroudsburg, Pa.

507,419. ELECTRIC HEATING AND WELDING APPARATUS. Charles L. Coffin, Detroit, Mich.

507,424. DISTRIBUTING FRAME FOR ELECTRIC WIRES. William S. Ford, Chelsea, and Bertram A. Lenfest, Wakefield, Mass.

507,449. RECIPROCATING ELECTRIC MOTOR. Henri Pieper, Fils, Liege, Belgium.

507,458. ADJUSTABLE INDUCTION COIL. Edgar M. Senseney, St. Louis, Mo.

507,463. SECONDARY BATTERY. Charles A. Smyth, Momence, Ill.

507,493. CONDUIT FOR ELECTRIC RAILWAYS. George F. Green, Kalamazoo, Mich.

507,510. RAILWAY TIME AND BLOCK SIGNAL. Adelbert H. Thorp, Toledo, O.

507,515. ELECTRICAL IGNITOR FOR GAS OR HYDROCARBON ENGINES. Paul A. N. Winand, Philadelphia, Pa.

507,516. ELECTRICAL IGNITOR FOR GAS OR HYDROCARBON ENGINES. Paul A. N. Winand, Philadelphia, Pa.

507,518. ELECTRIC APPARATUS FOR CONTROLLING SIGNALS. Michael B. Leonard, Richmond, Va.